Registered as a Newspaper in Ceylon

VOL. CVII. No. 1
JANUARY TO MARCH, 1951
(1st QUARTER, 1951)

COMMONWEALTH INST.
ENTOMOLOGY LIBRARY
28 AUG 1951
SERIAL As.3
SEPARATE

The Tropical Agriculturist

The Agricultural Journal of Ceylon

Founded in 1881
by the late MR. JOHN FERGUSON, C.M.G.

Published by
The Department of Agriculture
Peradeniya, Ceylon.

The

Tropical Agriculturist

Vol. CVII PERADENIYA, JANUARY—MARCH, 1951 No. 1

Page

Editorial—The Nutritive Value of Rice 1

ORIGINAL ARTICLES

Rice—an Appraisal of its Nutritive Value by A. A. Hoover, Ph.D. (Lond.) .. 3

Nutritional Aspect of Pureline Paddy by A. A. Hoover, Ph.D. (Lond.) and G. C. N. Jayasuriya, B.Sc. (Ceylon) 9

Notes on Legumes—I by W. R. C. Paul 15

Soil Conservation Pays Dividends by A. H. Faviell-Barrs 21

DEPARTMENTAL NOTES

The Vitamin "A" Contents of Ceylon Leafy Vegetables by C. Charavanapavan .. 23

Hybridization Methods with Paddy by J. J. Niles 25

Paddy Yields 30

SELECTED ARTICLES

Fodder for Livestock by Dr. H. W. Jack 31

MEETINGS, &c.

Minutes of the Meeting of the Central Board of Agriculture held on December 4, 1950 .. 37

Minutes of the Meeting of the Board of the Tea Research Institute held on December 20, 1950 52

Minutes of the 103rd Meeting of the Rubber Research Board held on November 6, 1950 55

Minutes of the 104th Meeting of the Rubber Research Board held on December 18, 1950.. 56

Minutes of the 105th Meeting of the Rubber Research Board held on February 7, 1951 57

RETURNS

Animal Disease Returns, October, November and December, 1950, and January, 1951.. 58

Meteorological Returns, November and December, 1950, and January and February, 1951 62

The

Tropical Agriculturist

JANUARY TO MARCH, 1951

EDITORIAL

The Nutritive Value of Rice

RICE is the staple food of more than half the world's population, and of the peoples of South and East Asia. The study of its nutritive value is, therefore, of the utmost importance to the health of this vast number of people among whom malnutrition is so prevalent. The United Nations Food and Agriculture Organisation in co-operation with other international bodies has accordingly made it its special concern to investigate the problems of nutrition in this region with particular reference to the improvement of rice as consumed and to rice diets.

To achieve this end, a Nutrition Committee for South and East Asia was established which met at Baguio in the Philippines in 1948, and at Rangoon in 1950, to consider all aspects of the problem, the background to which had been exhaustively presented in a valuble survey prepared by the Nutrition Division of F. A. O. entitled " Rice and Rice Diets ". The report of the Baguio meeting published under the title " Nutrition Problems of Rice-eating Countries in Asia " dealt with the nutritive value of rice, the effects of home-pounding, milling, parboiling, &c., on the chemical composition of the cereal, the losses in nutritive constituents as a result of cooking methods, the enrichment of rice, nutritional standards for rice, and the improvement of rice diets.

One recommendation of the Committee was that further studies should be made of the nutritional value of rice with particular reference to the influence of variety, climate, soil conditions, methods of cultivation, &c. In this number of the *Tropical Agriculturist* are published two articles by Dr. A. A. Hoover and Drs. Hoover and Jayasuriya of the Medical Research Institute, Ceylon, on the appraisal of the nutritive value of rice and the results of their investigations on the comparative nutritive values of local

rices. These articles are commended for the careful study not only of agriculturists, biochemists and medical men, but also of our statesmen, social workers, and the general public. They demonstrate clearly that "whole rice" as a cereal, is not much inferior to whole wheat and other grains. Besides containing high amounts of carbohydrates, it is relatively well supplied with protein of high biological value, and the vitamins thiamine (B1) and niacin. It is devoid of vitamins C and D, like other cereals, and poor in vitamin B2 (riboflavin), vitamin A and calcium. Losses of nutrients as a result of milling are, however, considerable, but parboiling reduces these losses to a very appreciable degree. Home-pounded rice, which is the form in which the greater part of locally-grown rice is prepared for consumption, is, therefore, the most satisfactory from the nutritive standpoint. This fact would account for the absence among our people of beriberi, a disease due to lack of vitamin B1, which is common in certain rice-eating countries. If most of the home-pounded rice is also parboiled we could be satisfied that the best use from the nutritional standpoint is being made of home-grown rice. The work of Hoover and Jayasuriya has also demonstrated that marked differences exist in the protein and thiamine contents of different varieties of local rices. Whether these are due to genetic or environmental factors has not yet been established and further investigational work on these lines is clearly indicated. The better utilisation of rice polishings (fine bran), which was shown by Joachim and Kandiah in their studies on Ceylon rices and rice products and by earlier workers to contain more than half the phosphoric acid, three-fourths the fat, and about a fifth of the protein of the whole grain (in addition of course to fair amounts of vitamin B), is also a subject for profitable investigation.

The deficiency of the cereal in calcium, vitamin A and riboflavin (vitamin B2) is, however, serious. If milk formed an important part of our diet, as it does in parts of North India, these deficiencies would be of little consequence, as milk is rich in all three nutrients. In the absence of milk, the liberal consumption of green vegetables and sprats or other type of small fish, supplemented by a little food yeast, would to a large extent rectify these deficiencies.

Further research on the methods of reducing losses of nutrients as a result of milling and processing in the case of paddy, and cooking in the case of rice, will no doubt result in the more efficient utilisation of the cereal. Future reports of the F. A. O. Nutrition Committee with their solutions to these problems should, therefore, prove of considerable interest and value to those guiding the destinies of the peoples of densely-populated South and East Asia.

Rice—an Appraisal of its Nutritive Value*

A. A. HOOVER, Ph.D. (Lond.)

SPECIALIST OFFICER, DEPT. OF BIOCHEMISTRY, MEDICAL RESEARCH INSTITUTE, COLOMBO

IN reviewing the biochemical and nutritional aspects of rice, I should like to treat the subject in the form of questions and answers.

How does rice compare nutritionally with other cereals such as wheat, maize and oats ? In answering this question, no comparisons should be made with processed cereals, since the nature of processing and the response to processing would vary from cereal to cereal. The correct procedure would then be to assess the relative merits of whole grains. It is well known that cereals supply us with carbohydrates, proteins, minerals, vitamins and to some extent with fat. The characteristic deficiencies in all cereals are total absence of vitamins C and D, low riboflavin and fat and very small amounts of available calcium. Among cereals yellow maize has the highest amount of vitamin A (705 I.U. per 100g.) and brown, uncooked rice comes next with 75 I.U. per 100g. (Rose, M.S., 1949). Rice, wheat and oats cannot be regarded as significant sources of vitamin A. Approximately 13 per cent. of the daily adult requirement of riboflavin is found in brown rice and this represents the average value for other cereals. On the other hand rice and other cereals are valuable sources of carbohydrates, proteins and the vitamins thiamine and niacin. 18 lines of pureline paddy grown in Ceylon were studied by the author and Mr. G. C. N. Jayasuriya and the average values for thiamine and niacin in brown rice were 592ug and 6907ug per 100g. respectively on a moisture free basis (1951.)

A popular misconception about rice is that it has much more starch than wheat. Actual values for carbohydrate in the common cereals are given in Table I—

TABLE I

Cereal		*g. carbohydrate/100g.*
Rice, brown	..	77.2
Wheat, whole	..	75.5
Maize, whole	..	73.4
Rice, polished	..	79.4
Wheat flour, white	..	77.2

* This paper was read at the Symposium on paddy held on December 1, 1950, during the Sixth Annual Session of the Ceylon Association of Science.

Thus there exists a difference of only 1.7g. or 6.8 Calories between 100g. each of brown rice and whole wheat. Between polished rice and white wheat flour the difference is only 2.2g. equivalent to 8.8 Calories. The energy values of whole wheat and brown rice are the same, 28g. of each cereal supplying 100 Calories.

When we consider proteins, cereals display pronounced differences in their protein content, the amino-acid composition, the biological value and the physical properties of the proteins. For comparison, the average protein percentages in some cereals are given in Table II—

TABLE II

Cereal		*g. protein/100g.*
Oat meal	..	14.2
Wheat, whole	..	11.1
Maize, whole	..	10.0
Rice, brown	..	8.8 (our figures)
Rice, polished	..	7.6

The actual contribution of cereals to the total protein of the diet would depend not only on the protein content of the cereals eaten, but also on the quantity of cereals consumed daily in any form. In a recent review, W. I. M. Holman (1946) had summarised the available data on the proportion of cereals in human diets and the figures in Table III for predominantly wheat eating countries were calculated from his data —

TABLE III

Country		*g. protein from cereal*
Great Britain	..	31
U. S. America	..	25
Canada ..	..	26

In Ceylon, according to information supplied by the Director of Census and Statistics (1949), 24g. of cereal protein were consumed by an adult per day during 1948-1949. This is equivalent to 11.1 ounces of polished rice, a figure closely corresponding to the amount quoted by Cullumbine and co-workers (1949). Thus despite the differences in the protein contents of wheat and rice, Ceylonese derive daily about the same quantity of protein from rice as Canadians or Americans from wheat.

The biological qualities of cereal proteins differ widely, partly due to differences in digestibility and partly due to the amino acid composition of the proteins. Mitchell and Block (1946) have collected most of the available data on the biological values of protein in adult human nutrition and the following figures in Table IV have been taken from their article—

TABLE IV

Source of protein		*Biological value*
Egg, whole	..	100
Rice, white	..	88
Wheat, whole	..	70
Wheat flour, white	..	41
Oats, rolled	..	87

In drawing conclusions from these figures, it should be remembered that (*a*) these results were obtained in different laboratories, and (*b*) experimental procedures have not been sufficiently standardised in human experiments to permit significant comparisons. With these reservations, rice proteins appear to be superior to wheat proteins. Another way of assessing the biological values of proteins has been suggested by Mitchell and Block (1946), and is termed ' the chemical score ' method by these authors. Table V gives the chemical scores of some familiar foodstuffs—

TABLE V

Source of protein	*Chemical score*
Egg, whole	100
Milk	68
Oats, rolled	46
Rice, white	44
Wheat, whole	37
Wheat flour, white	28

This method of assessment again points to the superiority of rice protein to wheat protein—a comforting thought to rice-eating countries. Thus the higher biological value of rice protein counterbalances the slight differences in cereal protein consumed daily as shown in Table III.

A pertinent question arises out of the above considerations. Accepting the figure of 24g. rice protein as the daily consumption by a Ceylonese adult, does this amount meet the most important function of any food protein, namely the adequate supply of the eight essential amino acids listed in Table VI ? Dr. William C. Rose (1949) has worked out the daily adult requirements with regard to these amino acids and his figures are compared in Table VI with what 24g. of rice protein would supply—

TABLE VI

Essential amino acids	*Rose's estimate of adult human daily needs, mgs.*	*mgs/100g white rice (N=1.22)*	*11.1 oz.* polished rice contain*	*Column 4 as % of Column 2*
Tryptophane	250	99	313	125
Phenyl alanine	1,100	509	1,607	146
Lysine	800	243	767	96
Threonine	500	311	982	196
Methionine	1,100	258	815	74
Leucine	1,100	684	2,160	196
Valine	800	479	1,513	189
Isoleucine	700	403	1,272	182

* 11.1 oz. polished rice contain 24g. protein.

The last two columns in Table VI indicate, in different ways, to what extent the amount of rice we consume daily would supply the essential amino acids. One cannot escape the conclusion that even polished or white rice, consumed in quantities prevailing in Ceylon (11.1 oz.), can more than meet the adult minimum requirements of essential amino acids, with the exception of methionine and lysine which, however, are supplied to an appreciable degree.

How does rice compare with other cereals with regard to vitamins ? Table VII gives the average figures for three cereals with respect to vitamins whose importance to human nutrition is well established—

TABLE VII

Cereal	*Vitamin A I.U./100g.*	*Thiamine**	*Riboflavin**	*Niacin**	
Rice, brown	75	527	140	6,146	
Wheat, whole	—	320–	100–	5,300	
		770	120		
Maize, whole	705	230–	130–	790–	
		740	150	6,210	(Burkholder et al, 1944)

* Values expressed as microgrammes per 100g.

Here again rice compares very favourably with other cereals, but the treatment to which rice is subjected before consumption is the main factor in the loss of its vitamins. This brings one to the subject of processing rice and its influence on the nutritive properties of rice.

It is common knowledge that in processing rice an appreciable amount of invaluable vitamins and other constituents is lost for human consumption. Thus when brown rice is milled to polished rice, M. C. Kik (1945) found serious losses as given in Table VIII :

TABLE VIII

Percentage losses on milling

76% thiamine
57% riboflavin
63% niacin
10% protein
85% fat
70% minerals

One of the effective methods of preventing such considerable loss of nutrients is our traditional method of parboiling rice. A modern development of the parboiling process is known as 'rice conversion' process, originated by Erich Huzenlaub and practised on a commercial scale in U. S. A. by a firm, Harwell and Mars of Houston. The product is called 'converted rice'. In this process, paddy, free from dirt, stones, chaff, &c., is introduced into a large vessel, which is then evacuated and hot water (75–80°C) subsequently introduced. The paddy is steeped in this hot water under a pressure of 80–100 lb. per sq. inch, for two to two and a half hours, the time and temperature of steeping depending on the variety used. The water is drained off and the paddy is introduced into a large, cylindrical, rotating, steamheated vessel. This is partially evacuated and steam introduced, and after a time, the paddy is dried in vacuo in this vessel itself to a moisture content of 15 per cent. The paddy is finally dried at atmospheric pressure and milled. A yellow coloured 'converted rice' is thus obtained. In a recent study

of this ' converted rice ' (Jacobs, 1944), the losses by milling were reported to be much less. Table IX gives a comparison of vitamin losses sustained by converted rice and raw rice by milling—

TABLE IX

Material	*Percentage losses in vitamins by milling*		
	Thiamine	*Riboflavin*	*Niacin*
Raw rice ..	76	57	63
Converted rice ..	8	29	22

This is certainly a very great step in conserving the vitamins in rice. It is even claimed that ' converted rice ' keeps well during storage and is fairly resistant to action of weevils. To give an idea of how much valuable nutrients is lost in ' bran ', the average composition of bran is given in Table X—

TABLE X

Constituents	*per 100g. bran*
Carbohydrates ..	41.8 g
Proteins ..	12.5 g
Fat ..	14.4 g
Ash ..	9.9 g
Thiamine ..	2,500 microgrammes
Riboflavin ..	268 do.
Niacin ..	32,000 do.

An interesting line to pursue is the recovery of these valuable constituents from bran in a form acceptable to human consumption.

The traditional method of washing rice before cooking results in a further loss of vitamins, but parboiled or converted rice stands up very well to this treatment. Losses by washing are presented in Table XI—

TABLE XI

Material	*Percentage losses in vitamins by washing (Kik, 1945)*		
	Thiamine	*Riboflavin*	*Niacin*
Rice, brown ..	21	8	13
Rice, polished ..	43	26	23
Rice, parboiled ..	7	12	10

Does paddy or rice lose much vitamin during storage ? The most appreciable loss is in thiamine. In Table XII figures are given for materials stored at 84°F—(Kik, 1945)—

TABLE XII

Material	*Percentage loss in thiamine during storage at 84°F for 3, 9 & 30 months*		
	3 months	*9 months*	*30 months*
Paddy ..	5	8	20
Rice, polished .	7	13	29

It is interesting to record the work of Barton-Wright (1944) on barley grains found in the tomb of King Tutankhamen (1350 B.C.). He found no thiamine at all, but found significant amounts of riboflavin and niacin. Losses during storage at 84°F for 30 months in riboflavin and niacin were not appreciable (c. f. Table XIII), (Kik, 1945)—

TABLE XIII

	Percentage loss of vitamins during storage for 30 months at 84°F	
	Riboflavin	*Niacin*
Paddy	6	4
Rice, polished	4	4

In this brief survey an attempt has been made to bring out the salient biochemical and nutritional aspects of rice. The nutritional properties of rice compare favourably with other cereals and even surpass them in some respects such as digestibility and biological value of its proteins. No doubt its nutritional properties could be enhanced by (*a*) attempting to increase the protein content and (*b*) conservation of its constituents by parboiling or the more effective large-scale ' rice conversion ' process.

REFERENCES

Barton-Wright, E. C. and others (1944). Nature, 153, 288.

Burkholder, R. P. and others (1944). Yale J. Biol. Med. 16,659.

Cullumbine, H. and others (1949). Ceylon J. Med. Science, 6,259.

Director of Census and Statistics (1949). F.A.O. April number, p. 236.

Holman, W. I. M. (1946). Nutr. Abstracts and Reviews, 15,402.

Hoover, A. A. and Jayasuriya, G. C. N. (1951). Tropical Agriculturist, p. 9, Vol. CVII. No. 1 (1951).

Jacob, M. B. (1944). The Chemistry and Technology of Food and Food Products. New York, Vol. 1, 644.

Kik, M. C. and Williams, R. R. (1945). Bulletin Nat. Res. Council, Washington. No. 112.

Mitchell H. H. and Block, R. J. (1946). Nutr. Abstracts and Reviews, 16,271.

Rose, W. C. (1949). Federation Proceedings, 8, 546 and Nutr. Reviews, 8, 118, 1950.

Rose, M. S. (1949). Rose's Foundations of Nutrition, 4th edition, New York.

Nutritional Aspect of Pureline Paddy *

A. A. HOOVER, Ph.D. (Lond.), and G. C. N. JAYASURIYA, B.Sc. (Ceylon)

DEPARTMENT OF BIOCHEMISTRY, MEDICAL RESEARCH INSTITUTE, COLOMBO

DURING the past twenty years much work has been done on the nutritional properties of cereals, notably wheat, maize and oats. With the development of rapid and convenient microchemical and microbiological methods, it was possible to study such problems as (*a*) verietal differences, (*b*) climatic differences, (*c*) effect of soil composition, and (*d*) effect of fertilizers on the vitamin, protein, mineral and fat contents. Since 1940, we have much useful information on some of these aspects but much of the work has been concentrated on wheat, maize and barley. In the School of Agriculture, University of Arkansas, Kik, Williams and others (1, 2) made a comprehensive study of rice grown in the United States and of the 16 varieties studied, 7 were investigated very thoroughly including the effect of milling, rinsing and cooking on their vitamin contents. They also studied the effects of storage and varietal influences on the vitamin content of rice.

Much of the work elsewhere has been chiefly concerned with the effects of processing of rice but the more fundamental problems have been studied more closely at the University of Arkansas. In Ceylon we are experimenting with nearly eighteen strains of pureline paddy and it would be useful to possess precise information on the biochemistry of the different strains in order to improve, among other things, the nutritional qualities of this cereal. We have studied the protein and vitamin contents of eighteen varieties of pureline paddy and all our experiments were conducted on ' brown rice ', which is defined as rice obtained from ' rough rice ' or paddy by careful removal of the hull without any injury to the germ and pericarp. This was achieved by the simple procedure of rubbing the grains between two pieces of boxwood, applying light pressure and collecting only the whole grains.

Moisture determinations were made according to the method recommended by the Association of Official Agricultural Chemists (3) and modified by Tate & Warren (4). Nitrogen estimations were done by the usual micro-Kjeldhal procedure using the catalyst mixture and digestion time recommended by Chibnall, Rees and Williams, (5). The vitamins thiamine, riboflavin and niacin were assayed by microbiological methods modified in our laboratory. Thiamine was determined by the use of *Lactobacillus fermenti*, riboflavin by *Lactobacillus Casei* and niacin by

* This paper was read at the Sixth Annual Sessions of the Ceylon Association of Science held on November 30 1950.

Lactobacillus arabinosus. These organisms are commonly employed for assaying these vitamins but we have modified existing methods to obtain better response and the details of such modifications will be published elsewhere.

We shall digress for a moment to comment on some observations made on other cereals such as wheat, maize and barley. With regard to wheat and barley rapid maturation was found to yield grains of higher protein contents than cereals grown in regions with mild humid climates resulting in a long growing season and slow maturation. Thus wheat and barley grown in the Steppes of Russia and in the Great Plains of North America consistently yielded grains with higher protein content (6, 7, 8). Genetic differences were also factors influencing the protein content although their contribution was not as great as environmental factors. For instance the protein content of hard red spring wheat harvested from 1925 to 1928 varied from 9 to 18 grams per cent. (9). Increasing the available nitrogen of the soil also resulted in an increased protein content of the grain. Thus wheat grown after legumes was generally of a higher protein content than when grown after cereal grains or grasses. Inorganic fertilizers also increased the protein content especially when application was delayed up to the time of blossoming. On the other hand studies on maize at the Illinois Experimental Station indicated pronounced variation in the protein content which was attributed to genetic differences (10). Thus in 39 inbred lines of maize studied the protein content ranged from 9.9 to 17.8 grams per cent. (11). Thus, age of maturation, location, fertilizers and genetic factors influenced the protein content of wheat, maize and barley. In the case of rice, however, there is hardly any information of this nature. According to our results, the protein content calculated on a moisture free basis varies from 7.69 to 11.88 or approximately 8 to 12 grams per cent. (Table II). The lowest values were obtained for the two strains of Suduheenati, being 7.69 for strain ICPY-15 and 8.06 for strain ICPY-19. The highest value of 11.8 was obtained for the 'white' variety Kurulutuduwi b-13. The other two white varieties Podiwi a-8 and Molagusamba g-18 have values of 10.75 and 10.25 respectively. The three 'white' varieties had an almost white pericarp unlike the rest whose colour varied from light to dark brownish red. With the information available we cannot ascribe these differences to genetic and/or environmental factors. Contrary to popular belief rice makes a substantial contribution to the protein in the Ceylonese diet. According to a Food Balance Sheet for 1948-49 prepared by the Director of Census and Statistics (21), of a total of 46g. protein per unit adult consumption per day, 24g. or a little over 50 per cent. come from cereals. One could see therefore, the nutritional significance of genetic or environmental studies to enhance the protein content of cereals in general and rice in particular.

In view of the relationship established between age and protein content of wheat and barley we have analysed our data for similar correlation. Table III gives the average nitrogen values of rice varieties arranged according to the age of maturation, namely 3, 3½–4, and 6 months. With the limited number of samples available our analysis has not revealed any significant relationship between age and protein content.

With regard to vitamin variations in cereals, some recent observations in America and Australia on wheat have established the influence of environment and variety on the thiamine content. For example, one variety of wheat grown in different districts in Australia varied in thiamine content from 360 to 690 μg/100g., clearly indicating the significance of environment (12). A comparison of the average values of different varieties of wheat grown in the United States and Canada showed variations, the thiamine content of soft winter varieties being less than the hard red spring variety (18). Twenty-eight varieties of maize in the United States showed a thiamine range of 230—760μg/100g. (13). M.C. Kik in Arkansas found that the thiamine content of rice was influenced by variety and to a lesser extent by location (2), and gave the thiamine range for 16 varieties of rice as 263–506μg./100g. Our experiments gave a thiamine range of 343–975 μg/100g. (Table II). Vellaiperunel 28724 gave the highest value of 975μg and Perillanel 26014 the lowest value of 343μg. The average thiamine value was 592 as compared with 335 for American varieties (2). The white varieties Podiwi a-8, Kurulutuduwi b-13 and Molagusamba g-18 gave values of 790, 760 and 501 respectively. These figures compare quite favourably with the average value of 592 for all varieties studied. Table III indicates that there is no significant relationship between age and thiamine content. On the other hand, from our results the coefficient of variation for thiamine has been calculated to be 25.7 (Table II) which seems to point to the possibility of genetic and/or environmental factors influencing the thiamine content. In passing it may be mentioned that although Kik (2) reported varietal variations other American workers (19, 20) have failed to observe significant varietal differences among the small number of samples studied.

Unlike thiamine, the riboflavin and niacin contents of wheat and rice do not appear to be significantly influenced by genetic and environmental factors (14, 15). On the other hand the niacin content of maize differs widely, different samples showing up to eightfold variation in the niacin content. A range of 790 to 6210 μg/100g for maize has been reported (16) and the differences are attributed to genetic factors. Richey and Dawson (17) from an extensive survey of the possibilities of breeding maize with a higher niacin content concluded that it was possible to develop strains with a higher niacin content. Our results with rice give (Table II) average values of 157 μg/100g for riboflavin and 6907 μg/100g for niacin, with ranges of 128–198 μg and 5573–7937 μg. respectively. The coefficients of variation are 12.74 for riboflavin and 10.03 for niacin which indicate that these two vitamins are not so appreciably affected by genetic or environmental influences, as thiamine with a coefficient of variation of 25.7. The ' white ' varieties compare favourably with other varieties and in fact, one of them Kurulutuduwi b-13 has the highest riboflavin value. Here again no correlation between vitamin content and age could be established.

Accepting the data of the Director of Census and Statistics that 24g. of cereal proteins are consumed per day by an adult, about 270g. brown rice would be necessary to supply this quantity of protein. This is equivalent

to a little less than 1½ 'chundus' of rice. This amount should, according to our results, supply the following amounts of vitamins :—

Thiamine 1.4 mg.	(70 per cent.	of recommended optimum requirement)	
Riboflavin, 0.38 mg	(13 per cent.	do.	)
Niacin, 16.7 mg.	(70 per cent.	do.	)

This would show that according to the present average rate of rice consumption, the outstanding vitamin deficiency would be riboflavin. We have not taken into account the appreciable vitamin losses resulting from milling, rinsing and cooking processes to which rice would be subjected before it is eaten. However the above calculation was intended to reveal the chief inherent vitamin deficiency of rice, which is shared by other cereals as well. (e.g. riboflavin values for whole wheat and maize are 100–120 μg and 130–150 μg. respectively).

SUMMARY

(1) Eighteen varieties of pureline paddy were studied including three varieties with a white pericarp.

(2) Marked differences exist in the protein and thiamine contents, probably due to genetic and/or environmental influences.

(3) There is no appreciable variation in the riboflavin or niacin values.

(4) The outstanding vitamin deficiency in rice is riboflavin, but this deficiency is common to cereals.

(5) The protein and vitamin contents of the three 'white' varieties compare very favourably with the average values for all samples.

(6) There is no correlation between age of maturation and the vitamin or protein content.

ACKNOWLEDGMENTS

We are grateful to Dr. M. F. Chandraratne, Department of Agriculture, for arranging the supply of all the strains of paddy we studied. We also wish to acknowledge the technical assistance of Messrs. O. Perera and A. P. D. G. S. Fonseka of the Medical Research Institute.

REFERENCES

1. Kik, M. C. and Williams, R. R. (1945). Bulletin Nat. Res. Council, Washington, No. 112.
2. Kik, M. C. (1945). Univ. Arkansas College of Agriculture, Bull. 458.
3. Methods of Analysis of the Association of Official Agr. Chemists, 1940, 5th edition, 353.
4. Tate, F. G. H., and Warren, L. A. (1936). Analyst, 61, 367.
5. Chibnall, A. C., Rees, M. W. and Williams, E. F. (1943). Biochem. J. 37, 354.
6. Bailey, C. H. (1925). The Chemistry of Wheat Flour, New York.
7. Wheat Studies, Food Res. Institute, (1934), 10, 229.
8. Bayfield, E. G. (1936). Ohio Agr. Exp. Sta., Bull. p. 563.

9. Bailey, C. H. (1941). Minn. Agr. Exp. Sta., Tech. Bull. p. 147.
10. Frey, K. J. (1949). Agron. J., 41, 113.
11. Rodriguez, L. D. and others (1950). Cereal Chem. 27, 67.
12. Lundie, K., and Robertson, I. (1941). 12th rep. Nat. Heath & Med. Res. Council (Australia), Appendix II., 9.
13. Conner, R. T. and Straub, G. J. (1941). Cereal Chem. 18, 671.
14. Andrews, J. S. and others (1942). Cereal Chem. 19, 55.
15. Tepley, L. J. and others (1942). J. Nutr. 23, 417.
16. Burkholder, P. R. and others (1944). Yale J. Biol. Med. 16, 659.
17. Richey, F. D. and Dawson, R. F. (1948). Plant Physiol. 23, 238.
18. Nordgren, R. and Andrews, J. S. (1941). Cereal Chem. 18, 802.
19. Cailleau, R. and others (1945). Cereal Chem. 22, 50.
20. Williams, V. R. and others (1943). Cereal Chem. 20, 560.
21. Director of Census and Statistics (1949). F.A.O. April, No. p. 236.

TABLE I

Pureline Paddy (Brown Rice)

		Moisture g/100g	*N g/100g*	*Protein NX6.25*	*B_1 µg/100g*	*B_2 µg/100g*	*Niacin µg/100g*
1.	Dahanala 37 YM 2,014 (3)	11·0	1·30	8·13	514	170	5,100
2.	Dewaredderi 26,081 (6)	12·0	1·57	9·81	366	117	6,438
3.	Kaluheenati 39YM 3,254(3½)	12·0	1·44	9·00	590	143	6,548
4.	Kohumawi B—11(6)	10·0	1·45	9·06	555	130	6,064
5.	Kurulutuduwi* b-13 (6)	10·5	1·70	10·63	682	177	6,880
6.	Madael 39 MY 137 (3½-4)	12·0	1·30	8·13	635	119	5,971
7.	Molagusamba* g-18 (6)	10·5	1·47	9·19	448	150	6,944
8.	Murunga 38 YM 137 (3)	11·5	1·63	10·19	537	140	7,025
9.	Oddavalan 2,449/20 (4)	11·0	1·29	8·06	405	114	6,171
10.	Pachchaiperumal 2,462/11 (3)	11·0	1·25	7·81	388	161	5,611
11.	Perillanel 26,014 (4)	13·0	1·35	8·44	298	121	5,973
12.	Podiwi* a-8 (6)	9·5	1·56	9·75	715	155	6,944
13.	Pokkali (4)	10·0	1·34	8·38	572	140	6,053
14.	Suduheenati ICPY-15 (3½)	12·0	1·08	6·75	574	134	4,905
15.	Suduheenati ICPY-19 (3½-4)	10·5	1·15	7·19	469	129	5,365
16.	Sulai 27,614 (3½)	10·0	1·63	10·19	477	132	5,973
17.	Vellai Illankalayan 28,061 (4)	11·5	1·37	8·56	380	137	6,836
18.	Vellaiperunel 28,724 (3)	10·5	1·54	9·63	873	149	5,823
	Average Values	11·0	1·41	8·83	527	140	6,146
	Standard Deviation	0·88	0·185	1·156	137	16·5	580

* Indicates "white" varieties, *i.e.*, with a white pericarp. ( ) Age of maturation is given within brackets.

TABLE II

Pureline Paddy (Brown Rice)

(*Values calculated on a moisture-free basis*)

		N g/100g	*Protein* NX6.25	B_1 μg/100g	B_2 μg/100g	*Niacin* μg/100g
1.	Dahanala 37 YM 2,014 (3)	1·46	9·13	578	191	5,730
2.	Dewaredderi 26,081 (6)	1·78	11·13	416	133	7,315
3.	Kaluheenati 39 YM 3,254 (3½)	1·64	10·25	671	162	7,440
4.	Kohumawi B-11 (6)	1·61	10·06	617	144	6,739
5.	Kurulutuduwi* b-13 (6)	1·90	11·88	762	198	7,689
6.	Madael 39 MY 137 (3½-4)	1·48	9·25	722	135	6,786
7.	Molagusamba* g-18 (6)	1·64	10·25	501	168	7,759
8.	Murunga 38 YM 137 (3)	1·84	11·50	607	158	7,937
9.	Oddavalan 2,449/20 (4)	1·45	9·06	455	128	6,935
10.	Pachchaiperumal 2,462/11 (3)	1·40	8·75	436	181	6,306
11.	Perillanel	1·55	9·69	343	139	6,866
12.	Podiwi* a-8 (6)	1·72	10·75	790	171	7,671
13.	Pokkali (4)	1·49	9·31	635	156	6,726
14.	Suduheenati ICPY-15 (3½)	1·23	7·69	652	152	5,573
15.	Suduheenati ICPY-19 (3½-4)	1·29	8·06	524	144	5,994
16.	Sulai 27,614 (3½)	1·81	11·31	530	147	6,637
17.	Vellai Illankalayan 28,061 (4)	1·55	9·69	441	155	7,725
18.	Vellaiperunel 28,724 (3)	1·72	10·75	975	166	6,506
	Average Values	1·59	9·94	592	157	6,907
	Standard Deviation	0·151	0·944	152	20	693
	Coefficient of Variation	9·47	9·47	25·7	12·74	10·03
	Range	1·23—1·90	7·69—11·88	343—975	128—198	5,573—7,937

* Indicates "white" varieties, *i. e.*, with a white pericarp. ( ) Age of maturation is given within brackets.

TABLE III

(*Values calculated on a moisture-free basis*)

	N g/100g	B_1	B_2 μg/100g	*Niacin*
	6 month-Varieties (5 varieties)			
Average value	1·73	619	163	7,434
	3½-4 month-Varieties (9 varieties)			
Average value	1·50	553	146	6,742
	3 month-Varieties (4 varieties)			
Average value	1·60	649	174	6,620

Photo 1.—Tropical kudzu

Photo 2.—Velvet bean

Photo 3.—*Sesbania cinerascens*

Photo 4.—*Indigofera teysmanii*

Photo 5.—*Desmodium limense*

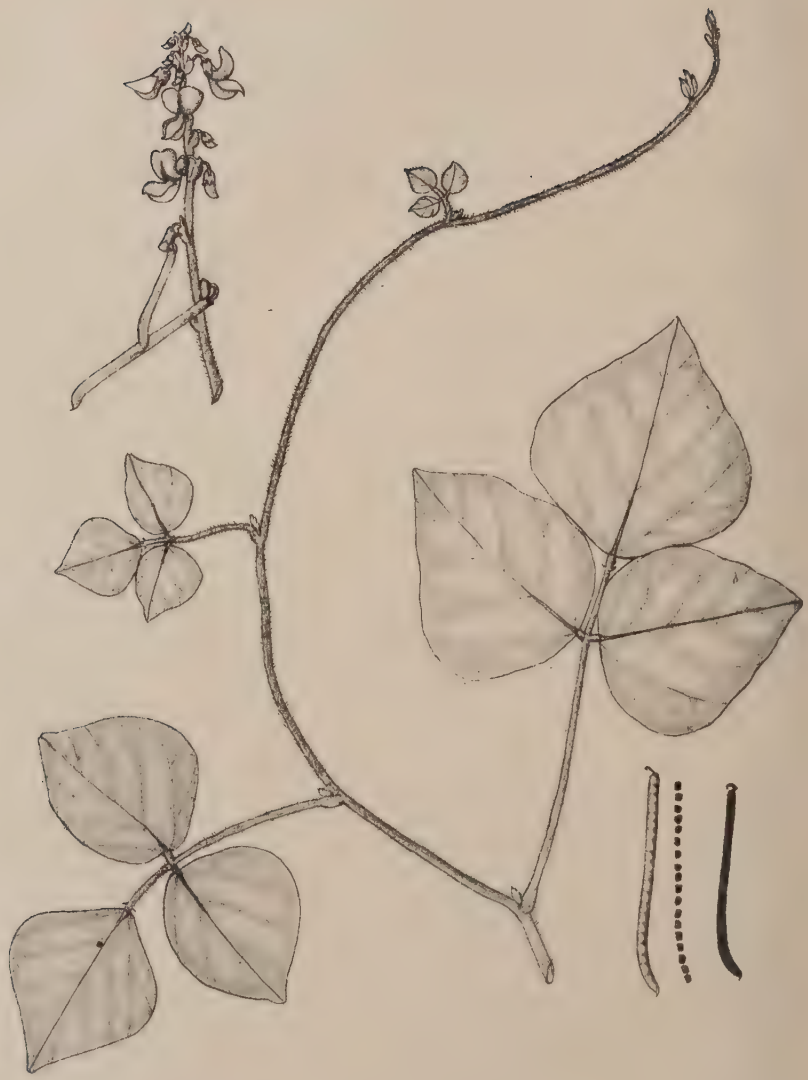


Fig. 1—Tropical kudzu (*PUERARIA PHASEOLOIDES* (Roxb.) Benth.)—Showing a part of the raceme with flowers and pods, the twining stem with trifoliate leaves and mature pods and seeds.

Notes on Legumes—I

W. R. C. PAUL
(Peradeniya)

IN a previous paper (5) the writer referred to some legumes in plantation and arable agriculture. Trials with legumes, some of recent introduction, have been continued at the Experiment Station, Peradeniya, and the notes in this series are based on the results that have been obtained.

Legumes in the tropics are of great variety and serve many purposes. Those that are the subject of this study are of value in soil improvement and crop protection or are of forage importance.

(*a*) *Ground covers.*—Crops such as rubber and coconuts need perennial covers which are tolerant of a certain degree of shade. If the rainfall is well distributed, *Pueraria phaseoloides* (Roxb.) Benth. (Fig. 1) is a vigorous ground cover. It is somewhat similar in its habit of growth to kudzu (*Pueraria thunbergiana* (Sieb. and Zucc.) (Benth) which is extensively grown in the southern United States for controlling erosion and as a pasture and hay crop (3). Kudzu which has gained so much popularity in the States after its introduction from Japan in 1876, does not thrive in the tropics. Several attempts to establish it in the observation plots at Peradeniya resulted in little or no success. After germination of the seed and some preliminary growth leading to the formation of a few stems and leaves, the plants remained in a more or less dormant phase. The response from cuttings was similarly unsatisfactory. There has so far been no record of the success of this species in any part of the tropics. On the other hand *Pueraria phaseoloides* known as tropical kudzu in Puerto Rico (10) can be regarded as the tropical counterpart of the true kudzu. It is used not only as a ground cover for preventing erosion but also as a forage legume in which cattle can graze. Although it forms a thick cover even under conditions of light shade as prevails under coconuts or young rubber it is slow in establishing itself from seed or even stem cuttings and these should be about 2 feet long. The crop is a perennial and seed production takes place only once a year during December to February. On a good soil, manured at the outset with phosphates, a heavy stand can be established in about 5 months time. The strain (Photo 1) raised from seed received from India some years ago has continued to maintain its superiority over other strains which were tested out (5).

For a more vigorous cover which forms a thick stand in much less time, one of the species of velvet beans has been found outstanding. It is an annual which is quicker established and produces a denser cover

than even any variety of cowpeas. This is the Mauritius or Bengal bean (*Stizolobium aterrimum* Piper and Tracy=*Mucuna aterrima* Holland) Fig. II and (Photo 2) seed of which was received from Queensland in 1949. A previous attempt to introduce velvet beans from the United States in 1927, at the Experiment Station proved a failure.

Like kudzu, velvet beans (*Stizolobium deeringianum* Bort. the Florida velvet bean, *S. niveum* D. C. Lyon bean, and other species) are grown in the southern United States where they are considered to be one of the best crops for soil improvement, especially on sandy soils, and also for feeding livestock (6). They are popular too in Queensland where they are mainly grown in cane fields for green manure purposes (7). The vines and leaves as well as the beans both in the pods and after shelling are of forage value.

The Mauritius velvet bean can be readily distinguished from the Florida, Lyon, Chinese and other varieties by its glossy black seed. The seed germinates well and the first pair of leaves which are single appear in about 4 days. The subsequent leaves are trifoliate and are borne on extensive vines. Growth is rapid and in 2 to 3 months time depending on the spacing adopted, a complete cover is formed. Flowering commences about 3 months from planting and soon afterwards the growth is so dense that all weed growth is suppressed. Flowering and pod formation continue throughout the life of the crop which lasts for about 9 months. A heavy mulch of rotting leaves is formed underneath and a considerable quantity of organic matter is thus added to the soil on which velvet beans are growing. This legume is useful as a green manure in orchards, young rubber and coconuts, though care should be taken to prevent the vines from climbing up the trees. Cattle can be introduced for rotational grazing on the cover under coconuts. On arable land in the dry zone, it is invaluable. On account of its marked resistance to drought it can be grown during the dry season from April to September thus fulfilling the conditions needed during that period of (*a*) protecting the soil from wind erosion, (*b*) keeping down weed growth, and (*c*) improving the fertility of the soil. Velvet beans can be grown in pure stand for grazing cattle or they can be mixed in pastures with other legumes and grasses. They can also be planted as a mixed crop with maize or sorghum but they should not be spaced too closely so as to interfere with the growth of the cereal. The space between the alternate rows can be used for the legume. After the cereal is harvested, the legume can be allowed to remain as a green manure or be grazed with cattle.

The vines of the velvet beans are slender, slightly ridged and extend over twenty feet in length. When allowed to grow on supports they may reach a distance of 40 feet or more. The leaves are large and smooth, the terminal leaflet being rhomboidal ovate and the lateral ones oblique, 8 to 10 in. long diagonally across and 3 to 5 in. wide. The flowers are borne on long racemes and are white with a tinge of purple. The pods number about 10 to 14 in a cluster and are borne singly. They are 4 to 5 in. long, curved with a greyish white pubescence of short, silky hairs. The seeds are black, hard and glossy when mature, 1.2 to 1.5 cm. long and 0.9 to 1.1 cm. wide,

Fig. II -MAURITIUS BEAN (*STIZOLOBIUM ATERRIMUM* Piper and Tracy). Showing the flowers, a trifoliate leaf, pods, a seedling and a portion of the stem.

with a raised white hilum nearly half as long as the seed. Each pod contains 3 to 5 seeds and about 470 seeds weigh one pound. A spacing of 3 feet by 3 feet using 2 seeds per hill is sufficient for a good stand to be established quickly and for this purpose the seed rate would be 20 lb. per acre.

Stylosanthes sundaica Taub. (= *S. mucronate* Willd.) known as the Townswille lucerne in Queensland (9, 11) is a native of South America but is now widely naturalised in many tropical countries including Ceylon. Seed of a markedly prostrate strain was received from Queensland in 1949. It is an annual which flowers and seeds in 4 to 5 months and regenerates itself prolifically. It is much smaller and less vigorous than the perennial *S. gracilis* H.B. and K. (Stylo or Brazilian lucerne) which may reach a height of 4 feet or more, if left uncut or ungrazed (5). There is the possibility that *S. sundaica* may be a satisfactory ground cover for tea on account of its prostrate habit. Even in contour strips it will be useful in holding up soil on sloping land under tea and being an annual it will add organic matter to the soil without the necessity of forking in the plants. Trials with this legume in tea and in coffee are in progress.

(*b*) *Erect bush covers.*—Amongst the less permanent and semi-woody covers which provide with repeated loppings a heavy quantity of leafy material under Peradeniya conditions is *Crotalaria Browneii* Bertol (5). It should be planted in contour strips 9 to 12 feet wide in rows 3 apart in tea, young rubber and coconuts for loppings which can be incorporated in the soil as green manure. The plants are capable of reaching a height of 7 to 8 feet.

Tephrosia candida DC which has been grown as a green manure in tea, rubber, and coconuts below elevations of about 2,000 feet, for many years in the past and was better known under the Assamese name of *Boga medelloa* has lost much of its popularity due to pod boring caterpillars which affect the seed. If the legume is not lopped it grows to a height of 11 to 12 feet and in areas where pod borer damage is not great, it should be planted in contour strips 9 to 10 feet wide in rows 2 to 3 feet apart. After about 5 months a heavy mulch of dead leaves is formed underneath and all weed growth in the planted strip suppressed. Every 18 months the plants can be removed and fresh strips established. It should be noted that this legume is very susceptible to eelworm (nematode) attacks.

(*c*) *Shade Trees.*—For crops like tea and cacao, quick growing leguminous trees which provide light shade and are of small girth so that nutrients in the soil are not unnecessarily used up in developing woody tissue are desirable. Such trees can be removed when they become too old at much less cost than those which develop a larger girth.

A promising tree from this point of view was found in *Sesbania cineraescens* Welw. which was introduced from Southern Rhodesia in 1943. It grows quickly and in about 4 months time it reaches a height of about 10 feet and commences to flower. It continues to flower and seed for about 7 years after which it dies back. The ultimate height of the tree is about 25 feet (Photo 3) and the girth of the stems does not exceed 10 in.

The leaves are pinnate, 10 to 14 in. long with 30 to 40 pairs of leaflets, each being about 2 mm. wide. Racemes of 4 to 6 yellow mottled flowers

are borne in the axils of the upper leaves. The pods are narrow and cylindrical, about 12 in. long with slight constrictions between the seeds which are oblong and of a dark greyish green colour (Fig. III).

The legume can be planted out in single contour rows at intervals about 40 feet apart and spaced about 6 feet apart within the row in tea. Every 3 years new rows can be planted between the old rows and when the trees are over 6 years old they can be taken out.

Another quick growing leguminous tree was found to be *Indigofera teysmanii* Miq., seed of which was obtained from Indo-China in 1949. It was reported to grow so rapidly in that country that it is used for regenerating land under shifting cultivation by reducing the intervals of rest between the clearings to 5 to 6 years (4). In the observation plot at Peradeniya, the plants reached a height of 21 feet (Photo 4) and a girth of 6 in. in one year by which time flowering took place. The leaves are pinnate and the flowers which are reddish pink in colour are produced on long racemes (Fig. IV). The pods are cylindrical 1½ to 2 in. long and black in colour when mature. There is every indication that this legume will be useful as a quick growing shade tree in tea, coffee and cacao, as a wind belt and also in lands under shifting cultivation.

(*d*) *Forage and Pasture legumes.*—Reference has already been made to the value of tropical kudzu and velvet beans as forage legumes.

The thornless mimosa (*Aeschynomone americana* Linn) of tropical American origin was found to thrive at Peradeniya on uncultivated or waste land. In Porto Rico it occurs in all parts being common on barren ground (2). It seeds prolifically especially during the months of November and December. When grown in a dense stand on a well manured soil it produces much leafy material. Several cuttings of the crop can be taken and when dried it produces a hay of attractive appearance and of high nutritive value as will be seen from the following analyses of this legume and of lucerne for comparison. Samples of both thornless mimosa and lucerne hay meals were taken from the plots at the Experiment Station and were analysed at the Chemical Laboratory of the School of Agriculture, Peradeniya, by Mr. F. N. Ponnamperuma, former Lecturer in Chemistry :—

	Thornless mimosa *Per cent.*	*Lucerne* *Per cent.*
Moisture	12.72	15.34
Crude protein	21.27	18.19
Mineral matter	7.7	7.8
Fibre	22.5	21.5

Though inferior to lucerne in palatability both in the fresh and dried condition, thornless mimosa can be fed to poultry and milk cows by mixing the hay meal with concentrates.

The seed should be broadcast at 40 lb. or more per acre so as to establish a close stand and in about 2 months time the first cutting can be taken when the plants are about 2 to 2½ feet high. In an observation plot of 1/120 acre sown on March 2, 1950, 5 cuttings were taken up to November 14, and a total calculated yield of 24 tons per acre of fresh material was

Fig. III—*SESBANIA CINERASCENS* Welw.—Showing the flowers on the left, the leaves on a terminal shoot in the centre and pods on the right.

Fig. IV—*INDIGOFERA TEYSMANII* Miq.—Showing on the left the pods, in the centre the leaves on a terminal shoot, and on the right the flowers.

Fig. VI—*DESMODIUM LIMENSE* var. *SANDWICENSE* (E. MEY.) SCHINDE.—A portion of the terminal shoot showing flowers and pods.

Fig. V.—THORNLESS MIMOSA (*AESCHYNOMONE AMERICANA LINN.*).—A portion showing the leafy stem on the left and a stem with flowers and pods on the right.

obtained. The percentage weight of the hay is 25 to 40 depending on the weather conditions. It has so far been possible to cut the crop every 2 months under favourable weather conditions.

If the soil conditions are poor, the plants tend to flower earlier with each successive cuttings, but there is the possibility that as the cuttings in the observation plots were approaching the months of November and December when the full flowering period takes place, that flowering became more marked. Observations on this aspect are being continued.

Care should be taken in drying the stems after cutting, not to expose them too long in the sun as otherwise the material will become bleached and its carotene content may be reduced. Under a strong sun 2 to 3 hours will suffice and the material should remain green but crisp to the feel of the hand. Drying indoors is even possible provided the stems are spread somewhat thinly on the ground. Both in drying in the sun and indoors, the leafy stems should be periodically turned over so as to bring about even drying. The hay should then be passed through a cutter or a hammer mill to convert it into a meal which can be stored in bags for use when required.

The plants grow to a height of 6 to 8 feet. The stems are slender and succulent but become woody as the plants get older. The leaves are pinnate, 2 to 3 in. long with 20 to 32 pairs of linear leaflets which are photosensitive, closing at dusk and opening at dawn and the flowers are small, salmon to pink coloured when opened (Fig. V.).

Through the courtesy of the Council of Scientific and Industrial Research, Australia, seed of *Desmodium canum* (Gmel.) Schinz. and Thellung was received in 1949, as a pasture legume and sown in an observation plot. In Hawaii, it is popularly referred to as the Kaimi Spanish Clover (1). The plants came up and seeded well but the leaves were somewhat coarse and leathery in texture. In the original plot, however two plants appeared different. They were taller, about 2½ feet high, the leaves were thinner and more succulent and the flowers were white in contrast to the pink flowers of the other plants. The seed of these white flowered plants (Fig. VI.) were collected and sown separately and the progeny showed similar characters to the two parent plants. The plants seed in about 2 to 2½ months time. The leaves are trifoliate, sometimes with a characteristic white strip along the mid-rib of each leaflet, the terminal one being slightly larger than the two laterals. The leaflets measure 1.5 cm to 6.0 cm long and 1.5 cm to 2.7 cm wide. The tender leaves are light green in colour and become darker green when they are older. The main stems terminate in the flowering shoots which are about 6 in. long. The standard petal has two green spots at the base. The pods are developed in pairs along the length of the inflorescence. There are about 8 to 9 one seeded fruits per pod. This legume (Photo 5) which has now been identified as *Desmodium limense* var *Sandwicense* (E. Mey.) Schinde by Mr. J. E. Senaratne, Research Assistant in Systematic Botany is superior to *D. canum* as a pasture legume. It is readily eaten by cattle and stands up to grazing well. It is useful as a forage crop grown alone and in mixture in pastures.

I have to thank Messrs. D. S. Goonetilleke and R. Pathmanathan, Assistant Farm Officers at the Experiment Station, Peradeniya, for their work in looking after the observation plots and in keeping records.

SUMMARY

Experiment Station.—Trials with different legumes some of recent introduction were continued at Peradeniya. The Mauritius bean (*Stizolobium aterrimum* Piper and Tracy) has been found to be an exceptionally vigorous ground cover that will completely suppress all weed growth. It is also markedly drought resistant. It is valuable as a soil renovator and for forage purposes.

Sesbania cinerascens Welw. obtained from South Rhodesia is a small quick growing tree whose girth does not exceed 10 in. It provides a light feathery shade which makes it useful in tea.

Another tree of rapid growth but with a larger canopy is *Indigofera teysmanii* Miq. which was introduced from Indo-China. It reaches a height of 21 feet in one year. It is considered suitable as a shade tree for tea, coffee and cacao and as a wind belt, as well as for the regeneration of land subject to shifting (*chena*) cultivation.

The thornless mimosa (*Aeschynomone americana* Linn.) can be cut several times a year and a hay meal of high nutritive value made for feeding poultry and milk cows.

Desmodium limense var *Sandwicense* was found in a plot of *Desmodium canum* (Gmel.) Schinz. and Thellung raised from seed obtained from Australia and it is useful as a forage crop grown alone and in mixture in pastures.

REFERENCES

1. Hosaka, E. Y. and Ripperton, J. C.—Legumes of the Hawaiian ranges. Bull. No. 93, Agric. Experiment Station, Hawaii.
2. Kinman, C. F.—Cover crops for Porto Rico—Bull. No. 19, Agric. Experiment Station, Porto Rico
3. Mc Kee, R. and Stephens, J. L.—Kudzu as a farm crop. Farmers Bull. No. 1923, U. S. Department of Agric.
4. Paul, W. R. C.—Roving Agriculture and the problem of dry farming. The Tropical Agriculturist, Vol. 105, No. I, 1949.
5. Paul, W. R. C.—On the value of some legumes. The Tropical Agriculturist, Vol. 105, No. 3, 1949.
6. Piper, C. V. and Morse, W. J.—Velvet bean. Farmers Bull. No. 1276, U. S. Department of Agriculture.
7. Pollock, N. A. R.—The velvet bean. Queensland Agri. Journal, Vol. 42., Part I., 1934.
8. Scott, J. M.—Velvet bean varieties. Bull. No. 152, Agric. Experiment Station, Florida, 1919.
9. Schofield, J. L.—Introduced legumes in North Queensland. Queensland Agric. Journal, Vol. 56, Part 5, 1941.
10. Telford, E. A. and Childers, N. F.—Tropical Kudzu in Puerto Rico Circ. No. 27 U. S. Department of Agriculture, 1947.
11. White, C. T.—Wild lucerne. Queensland Agriculture Journal, Vol. 42, Part I., 1934.

Soil Conservation Pays Dividends

A. H. FAVIELL-BARRS

THE move by the Ceylon Government to teach the public the importance of preventing soil erosion has not come too soon. I only hope the public will give this important work its full co-operation, and so help to preserve Ceylon's greatest asset, her very fertile land.

As a Rubber Planter I have always been interested in erosion in rubber plantations, and I would like to recount my observations on a large estate. Firstly, I will deal with about a 1,000 acres which was planted between the years 1907–1923. This was subjected to clean weeding for many years, and therefore we must presume that most of the original " top soil " was lost by erosion.

Cover crops were introduced in Ceylon around the years 1923/25 by the late Messrs. W. Y. Mackintosh and G. F. Pickthall, and one of the first experimental plots of *Vigna Oligosperma* was planted by myself under their direction. These two pioneers realized that clean weeding was wrong and that something must be done about re-making top soil and that this could best be done by planting a leguminous cover.

From 1926 to the present day the 1,000 acres has been continuously under different kinds of leguminous covers ; starting with *Vigna Oligosperma*, then *Calapogonium Mucunvides*, *Pueraria Javanica*, and *Desmodium Ovalipolium*, and at the same time being kept entirely free of weeds and grasses which are known to be inimical to rubber. From careful examinations one can say with safety that after 25 years of continuous covers a great deal has been achieved to re-make the top soil.

The making of top soil is a very slow process ; one may ask, have these efforts proved worth while ? and, the answer without reservations is decided, *yes*. This area I have been dealing with is old seedling rubber 43 years old which is still yielding between 550 lb. to 650 lb. per acre, and showing no signs of falling off and with excellent bark renewals. This compares most favourably with other old rubber of about the same vintage, and the same stand per acre which has not received the same careful attention over the years and with grasses and weeds allowed to take control. This rubber to-day yields only about 400 lb. per acre, the tapping systems being the same.

I feel with this evidence it is obvious that the estate has been amply repaid for the efforts to re-build its top soil and minimise erosion. At the same time, drains and silt traps have always been kept in good order, and again to illustrate the value of cover crops, silt traps which have not been

cleaned for 5 years show only a very small deposit of silt. This is all the more remarkable as the rainfall for this area is between 190 in. and 200 in. a year.

I now pass to the apparent advantages of maintaining old rubber areas under good covers in the effort to re-build humus previously lost by the earlier years of clean weeding. In re-planting these areas compared with areas where no soil conservation had been done and where the usual grass, weeds, and *Mikania* has been allowed to take control, the difference is most obvious. Re-planted clearings opened from old rubber where good covers had existed have shown at least a year's growth in height and girth better than the areas where no cover had been established. From this alone it is obvious that the re-made humus has proved its value because the cover crop areas will come into bearing at least one year quicker than the other.

Lastly, I come to perhaps the most interesting of my observations, the reclamation of a neglected 400 acres of old seedling rubber, full of grass and weeds. To eradicate the grass and weeds, etc., the accepted method of cleaning is by the use of " mamoties," but it soon become apparent that in patches where *Mikania* predominated, whatever humus had been made would be lost by the scraping of the " mamoties," exposure, and erosion. So, instead, I decided to use Sodium Arsenite as a weed killer and after a period of experimenting, this method proved ideal and the results obtained over the 400 acres have certainly proved better than expected.

Briefly, to reclaim such areas the ground weeds are sprayed with Sodium Arsenite, so after 4 to 5 days, all grasses and weeds, including *Mikania*, are usually dead. Within 10 days when the effects of the Sodium Arsenite have worn off, the area is planted with leguminous cover. In the meantime the dead weeds have formed a " mat " or " layer " of decaying compost which has two main functions, (*a*) it prevents erosion and exposure, (*b*) the newly planted cover crop makes full use of the compost and accumulated humus. In less than 3 months sufficient cover will have been created to protect the soil which has thus never been seriously exposed. The first reclamation was done a little over 3 years ago and when comparing this with later areas and those still to be done, there is a noticeable improvement in foliage and yield which I presume must be directly due to the fertilizing effects of this new source of compost and humus.

The Vitamin "A" Contents of Ceylon Leafy Vegetables

BY

C. CHARAVANAPAVAN

DURING recent years increasing attention has been given to the problem of nutrition in Ceylon. It has been found that the diet of most people in Ceylon is deficient in milk, butter and eggs which are rich sources of vitamin A. This deficiency can be remedied to a large degree by the use of leafy vegetables in the diet.

Leafy vegetables are known to contain carotenes—alpha, beta and gamma, which are precursors of Vitamin A and are converted into Vitamin A in the body and stored in the liver. These carotenes are yellow pigments which can be estimated by colorimetric methods. Twenty-five leafy vegetables of local origin were analysed by the method adopted by C. R. Austin and J. Shipton—Journal of the Council for Scientific and Industrial Research (Australia) 1944, Vol. 17, p. 115.

RESULTS

The following are the results of the analysis of 25 local leafy vegetables and those of American, Indian and Malayan leafy vegetables. The figures wherever possible for the vitamin A contents of the same leafy vegetables as the local ones reported in the United States Department of Agriculture Hand Book, No. 8, 1950, the Indian Health Bulletin, No. 23, 1937, and the Department of Agriculture, Federation of Malaya, Scientific Series, No. 23, 1949, respectively, are furnished for comparison:—

	Botanical and English Names	*Sinhalese Names*	*Tamil Names*	*Vitamin A contents in I.U/100 grammes*			
				Ceylon	*American*	*Indian*	*Malayan*
1.	Alternanthera triandra	Mukunuwenna	Ponnankani	536	—	—	—
2.	Sasbania grandiflora	Kathurumurunga	Ahathi	1,916	—	—	—
3.	Raphanus sativus (Radish)	Rabu	Mullanki	325	—	—	—
4.	Hydrocotyl asiatica	Gotukola	Vallarai	355	—	—	—
5.	Daucus carota (carrot)	—	—	1,050	—	—	—
6.	Amaranthus viridis	Kurakola	Sirukeerai	1,620	—	—	2,667
7.	Rivea ornata	—	Musuttai	1,900	—	—	—
8.	Moringa oleifera	Murunga	Murungai	2,750	—	11,330	—
9.	Amaranthus olaraceous	Thampala	Keerai	3,366	—	—	—
10.	Amaranthus gangaticus	Rathu Thampala	—	2,216	—	2,500	3,333
11.	Spinacea olaracea (spinach)	Niviti	Pasali	978	9,420	2,630	8,000
12.	Talinum patens	Gasnivithi	—	771	—	—	—
13.	Ipomea aquatica	Kankun	Kankun	2,476	—	3,270	4,667
14.	Brassica olaracea	Gowa	Kowa	1,538	80	2,000	4,333
15.	Boerhaavia diffusa	Saarana	—	2,183	—	—	—
16.	Solanum Nigrum	Kalukanweriya	Manalthakkali	9,666	—	—	—
17.	Lasia spinosa	Kohila	—	1,231	—	—	—

	Botanical and English Names	Sinhalese Names	Tamil Names	Vitamin A contents in I.U/100 grammes			
				Ceylon	American	Indian	Malayan
18.	Portulaca olaracea	Genda	—	2,373	—	—	—
19.	Cardiospermum halicacabum	Valpenela	Mudakkottan	3,360	—	—	—
20.	Aerua lanata	Polpala	—	4,260	—	—	—
21.	Lactuca sativa (lettuce)	—	—	828	540	2,200	1,620
22.	Manihot utilissima	Manjoca	Maravalli	2,933	—	—	—
23.	Allium ascalonium (onions)	Rathu lunu	Eravenkayam	2,616	50	—	—
24.	Ipomea batatas (ord) (sweet potato)	Batala	Vattalai	1,423	—	—	7,770
25.	Ipomea batatas (yellow) (sweet potato)	Batala	Vattalai	2,026	—	—	—

DISCUSSION

An examination of the results indicates that most of the popular leafy vegetables grown in Ceylon are potent sources of Vitamin A. One common but rarely known leafy vegetable—Kalukanveriya, S., Manalthakkali, T. (Solanum Nigrum) gave the highest figure. The divergence in the figures for the same leafy vegetables of America, India and Malaya, compared with those found for the Ceylon leafy vegetables, is not difficult to explain. It is known that the Vitamin A contents of leafy vegetables can vary as a result of climatic and soil conditions.

Hybridization Methods with Paddy

BY

J. J. NILES

ASSISTANT IN ECONOMIC BOTANY

EXTENSIVE use of paddy selections of hybrid origin appears to be confined to Japan and the U. S. A. ; the percentages of selections of hybrid origin under issue in these two countries, according to the World Catalogue of Genetic Stocks, are 64 and 47, respectively. The percentage of hybrids listed from the rest of the rice-growing countries is under three. Systematic work on the hybridization of paddy in Ceylon is still in its infancy. The present paper records the results of preliminary studies in technique.

ANTHESIS

At Peradeniya, opening of the glumes commences after 10 a.m. and ceases by 2 p.m. Blooming reaches its peak during the interval 11.15 a.m. to 11.45 a.m. Most of the spikelets are observed to have opened by 12 noon. On rainy days with very cloudy weather blooming takes place even as late as 4.30 p.m. The glumes generally remain open for 39 to 62 minutes, though in some instances the period may exceed 90 minutes or more.

Ordinarily a panicle completes emergence from the flagleaf in about 3 days. The spikelets commence opening a day or two after emergence. If the panicle emerges before noon, blooming may commence on the same day. It was observed that the dehiscence of the anthers, even within the same variety, takes place either simultaneously with the opening of the glumes, or before, or soon after they emerge from the glumes. All the spikelets in a panicle complete blooming by the 8th day from the commencement, with the majority opening on the 3rd day. Thus panicles which were in the 3rd day of blooming are preferred for emasculation, particularly when earlier blooming was forced by isolating the panicle, as the largest number of flowers respond on that day.

EMASCULATION METHODS

In the method normally adopted at Peradeniya, all the spikelets which have bloomed previously are clipped off from the panicle 3 to 2 hours before the natural time of blooming. The spikelets are then emasculated immediately afterwards. At Peradeniya, the period 7.30 a.m. to 9.15 a.m. is found to be the most suitable and the most convenient time to emasculate. It is observed

that the anthers handled after 9.30 a.m. often dehisced. Emasculation is always commenced with the top spikelets, and progress downwards because of the basipetal nature of flowering. Moreover, the likelihood of pollen falling into the open spikelets below is minimised. Immediately after emasculation, each spikelet is examined with a lens in order to ensure the absence of pollen. All the unemasculated spikelets are then clipped off, and the panicle is covered with a paper bag. Instruments are sterilized with methylated spirits during the operation.

A variety of emasculation methods is adopted by rice-breeders. Torres (1923) describes a method in which the upper portion of the glumes are clipped off transversely the previous afternoon and emasculated ; pollination is done the next morning. Sharngapani (1924) describes a method used in Bengal, in which the two glumes are gently pulled apart with the fingers and the stamens removed with a pair of fine forceps. This method unless very carefully followed leads to the damage to the lodicules. Ramiah (1927) reported a method which has been successfully adopted in Coimbatore and elsewhere, in which the panicle is enclosed in a brown paper envelope 1 to 1½ hours before the natural time of blooming. On the removal of the envelope 15 to 30 minutes after inversion, all the spikelets which are due to open on that day open in a flush, forcing the extrusion of undehisced anthers. The anthers are then removed without difficulty. The efficacy of this method was investigated in Peradeniya.

Paper covers of seven colours were tested. The covers measured 14 in. by 4½ in. Covers 1–5 were of tissue paper, and covers 6 and 7 were of thick, opaque paper. Panicles of *Panduruwi* which were selected for each treatment were examined the previous evening and the spikelets which had opened previously were removed. The bags were inverted over the panicles the next morning at the times specified in Table I—

Table I

	Time of inverting bags	*1st Spikelet*		*3rd Spikelet*	
		Interval between treatment and blooming	*Temperature inside cover at time of blooming*	*Interval between treatment and blooming*	*Temperature inside cover at time of blooming*
	A.M.	*Min.*	°*F.*	*Min.*	°*F.*
1. White	7.41	177	85·1	183	86·0
2. Blue	7.43	114	85·1	159	86·5
3. Green	7.48	129	86·9	142	86·9
4. Yellow	7.47	136	87·8	174	87·4
5. Red	7.54	134	86·0	173	88·7
6. Brown	7.51	121	86·0	131	88·7
7. Black	7.45	104	86·9	126	87·8
8. Control	—	177	—	216	—

The results presented in the above Table clearly show that the black and brown covers were the most effective. The results obtained in this experiment has been confirmed in subsequent tests. It is evident that the

number of spikelets which open under the conditions prevailing at Peradeniya is, however, comparatively small, except when the covers were inverted after 10 a.m.; but at such a time there is considerable risk of the anthers dehiscing when handled. This method accordingly appears unsuitable for Peradeniya conditions.

The hot water immersion method of Jodon (1938) was tested in Peradeniya with satisfactory results. The results with this treatment were, however, not consistent. It was tested on many different varieties over a period of six months. The initial temperature of the warm water used ranged from 98·6 °F to 111·2 °F. and the period of immersion ranged from 3 to 14 minutes. The time of the commencement of immersion varied from 8·25 a.m. to 9·52 a.m., but was not an important factor. The most satisfactory results were obtained by the use of water at an initial temperature of 111·2 °F. for a period of 10 minutes. The atmospheric temperature which ranged between 77 °F. and 87·8 °F. during the treatments did not seem to have any effect on the response to this treatment. The varieties *Panduruwi* and *Taichu No. 65* responded well, while *Vellai illankalayan*, *Aikoku*, and *Norin 25* gave poor or no response. The other varieties gave inconsistent results. Fine-grained varieties seem to respond better than coarse-grained varieties. Differences in behaviour, however, cannot be solely explained on morphological grounds. Factors like panicle age seem to affect the response to this treatment. Panicles whose age from the time of emergence is under three days, give little or no response.

The writer usually adopts Jodon's method as a preliminary. The panicle which is to be emasculated is usually first treated with warm water at an initial temperature of 111·2 °F for 10 minutes. If the spikelets reacted and the stamens came out, there was no further difficulty. Otherwise the opening of the glumes was assisted with a needle. Even if the stamens remained inside after the forcing open of the glumes, it was not difficult to remove them, as the filaments would have elongated as a result of the warm water treatment. This preliminary treatment was also advantageously adopted in the new technique of emasculation developed by the writer and described below.

In the forenoon before a spikelet is due to open the anthers are pushed up by the rapidly elongating filaments, as shown in Fig. 1 *a* and *b*. Shortly after the anthers reach the apex as in Fig. 1 *c*, the glumes open. In this technique the upper portion of the glumes, together with all the anthers inside it are clipped off in one operation with a curved pair of scissors, when the anthers reach the stage shown in Fig. 1 *c*. It is quite simple to perform this operation, as the position of the organs inside the spikelet is clearly seen by holding it in transmitted light. This method is much easier to adopt in varieties in which the stigmas are pigmented as their exact position is more clearly seen through the glumes. Examination of the stigmas, after emasculation shows that there is no pollen on them, in spite of the fact that this operation is done close upon the natural time of blooming. A much large number of spikelets can be emasculated per day by this technique than is possible with any of the other methods described above. By immersing the panicle in

warm water 3 to 2 hours before the natural time of blooming, it is possible to make the spikelets reach the stage shown in Fig. 1 *c* within 10 minutes. This eliminates chances of the anthers dehiscing and also makes it possible to handle more spikelets in a day. In this method 1·2 per cent. selfing has been recorded. The cup-like nature of the emasculated spikelet facilitates the examination of the stigmas, and eases pollination. It is found necessary to keep the panicle bagged till the hybrid seeds mature, particularly during wet weather. The seeds which form assume the shape shown in Fig. 1 *d*.

POLLINATION METHODS

Many different methods are practised by rice-breeders for obtaining and applying pollen. Most of these were tested by the writer and the undermentioned methods were found satisfactory.

A well developed, unopened spikelet, in which the anthers are just touching the roof of the glumes is removed. The glumes of the selected spikelet are gently pulled apart with the fingers and the stamens in which the anthers had not dehisced, are carefully extracted by means of their filaments. These stamens are placed on the palm of the hand or in a watch-glass and examined with a lens for the right stage of ripeness. In an anther which is about to dehisce, the two lobes assume a characteristic consistency, and release pollen grains when lightly pierced with a needle. An anther in such a stage of ripeness when taken on a mounted needle and gently rubbed on the inside of the glumes of the " female " spikelet, dehisces releasing a cloud of pollen. When partially burst anthers are used, the stigmas are lightly touched with it.

A method which the writer finds very effective is to place 4 to 5 ripe anthers in the spikelet of the ovule parent by about 11 a.m. The empty anther sacs are removed by 3 p.m., using a chip-blower or mounted-needle. This pratice, in addition to giving good results, greatly reduces the time that is taken up in pollination.

It is advantageous to delay the pollination till the 3rd day of emasculation, in order to detect any spikelets that may have been accidentally selfed. Selfed ovaries swell by the 3rd day. On the other hand, results obtained in Peradeniya indicate that there is an appreciable loss in receptivity by the 3rd day.

In pollinating spikelets in which the glumes had been forced open either by the method described by Sharngapani or Jodon, the writer has adopted a modification in order to prevent any damage to the lodicules. By inserting between the lemma and the palea, a pin possessing the shape of an inverted V, the palea is obliquely pushed backwards and is held in position by the left arm of the inverted pin, as shown in Fig. 2. This method of obliquely turning the palea to a side, instead of pulling both the glumes apart, prevents any damage to the lodicules. It also has the advantage of keeping the spikelet open till the entire operation of pollination is complete.

The use of a V-shaped pin to keep the spikelet open.

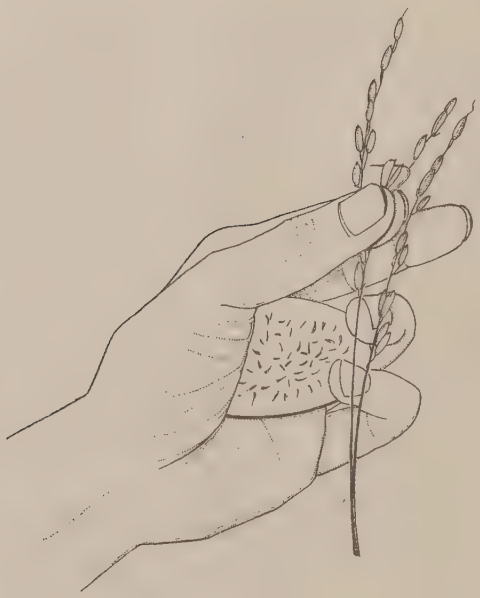
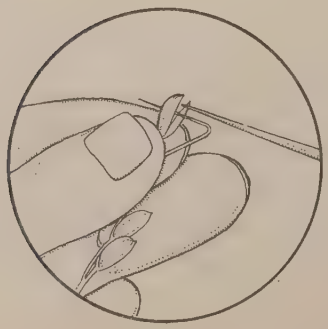


Fig. 2.



GERMINATION OF F_1 SEED

As the ordinary methods of germinating seed in porous dishes leaves much to be desired, the following method based on Mendiola (1926) was adopted. The grains after the removal of the glumes, are steeped in a 0·1 per cent. solution of Mercuric chloride for 15 minutes, and then washed 3 times in sterile water. Each naked kernel is then transferred into a test tube of sterilized Agar containing the following :—

Calcium nitrate	.. ..	0·100	per cent.
Potassium biphosphate	.. ..	0·025	,,
Magnesium sulphate	.. ..	0·225	,,
Ferric phosphate	.. ..	0·005	,,
Ammonium sulphate	.. ..	0·100	,,
Agar	.. ..	Two	,,

The Agar medium is autoclaved in test tubes for 15 minutes under 15 atmospheres of pressure.

This method gives nearly 100 per cent. germination, even in the case of the mutilated seed obtained by the writer's new technique of emasculation. The germination of the unhusked grain in Agar is found to be comparatively poor. The naked rice, on the other hand, germinates within 2 days and the seedlings grow to a height of 7 in. within 10 days. When they reach this stage they are planted out in pots.

SUMMARY

The results of studies in hybridization technique with paddy are presented.

Records made at Peradeniya of the anthesis of paddy indicate that the period 7.30 a.m. to 9.15 a.m. is the most suitable time to emasculate.

The results of the writer's tests of emasculation methods in use in other countries are described.

Details of an emasculation technique developed by the writer are given. The technique entails the clipping-off in one operation of all the anthers and the upper half of the glumes.

A method of germinating F_1 seed is described.

ACKNOWLEDGEMENTS

I am grateful to Dr. M. F. Chandraratna whose encouragement and help made this study possible. I am also thankful to Mr. A. George Alwis for the drawings made.

LITERATURE CITED

Torres, J. P., 1923.—Some notes on rice hybridization work. *Philippine Agr. Rev.*, 16. 46–48.

Sharngapani, S. G. 1924.—A few observations on paddy. (*Oryza sativa*) crossing. *Agr. Jour., India.*, 19, 48–50.

Ramiah, K., 1927.—Artificial hybridization in rice. *Agr. Jour., India.*, 22 : 17–22.

Jodon, N. E., 1938.—Experiments on artificial hybridization of rice. *Jour. Amer. Soc. of Agron.*, 30 : 294–305.

Mendiola, N. B., 1926.—A manual of plant breeding for the tropics. *Manila : Univ., Phil. Bureau of Printing.*

2—J. N B 6008 (3 51)

Paddy Yields

Season, Year	Paddy—Extents Sown Yields: Extent Sown (acres)	Yield–Paddy: Bushels	Yield–Paddy: Long Tons	Yield–Paddy: Metric Tons	Rice Production: Rice available for consumption. Metric Tons (1)
Maha 1943–44	680,919	9,119,013	182,380	185,275	103,309
Yala 1944	349,313	4,447,192	88,944	90,356	50,382
Total 1944	1,030,232	13,566,205	271,324	275,631	153,691
Maha 1944–45	633,563	7,900,411	158,008	160,516	89,504
Yala 1945	262,097	2,900,059	58,001	58,922	32,855
Total 1945	895,600	10,800,470	216,009	219,438	122,359
Maha 1945–46	610,070	7,847,668	156,953	159,444	88,906
Yala 1946	317,008	3,502,851	70,057	71,169	39,684
Total 1946	927,078	11,350,519	227,010	230,613	128,590
Maha 1946–47	616,507	8,013,348	160,267	162,811	90,783
Yala 1947	310,176	3,506,982	70,140	71,253	39,731
Total 1947	926,683	11,520,330	230,407	234,064	130,514
Maha 1947–48	—	—	—	—	—
Yala 1948	343,055	4,344,562	86,891	88,270	49,210
Total 1948	—	—	—	—	—
Maha 1948–49	635,987	9,007,580	180,152	183,012	102,047
Yala 1949	436,816	6,227,667	124,553	126,530	70,553
Total 1949	1,072,803	15,235,247	304,705	309,542	172,600
Maha 1949–50	671,916	9,432,925	188,659	191,653	106,865
Yala 1950 (2)	409,700	5,567,505	111,350	113,118	63,075
Total 1950 (2)	1,081,616	15,000,430	300,009	304,771	169,940

(1) Total production of paddy (less 15 per cent. seed allowed and 3 per cent. waste) converted into rice. Extraction rate 68 per cent.

(2) Revised estimate.

Fodder for Livestock

DR. H. W. JACK

(Reprint of a Paper issued by the Office of the Commissioner-General for the United Kingdom in South-East Asia)

THE need for a more balanced agriculture in South-East Asia has been stressed for many years but progress has been conspicuously slow largely because of the considerable problems involved in providing, adequately and economically, a suitable food supply for the raising of livestock.

In many areas the lack of suitable conditions for the growing of fodder crops is well known especially in those areas where wet rice cultivation occupies the land for the major portion of the year and where, between seasons, cultivation of fodder crops is not practicable because of lack of soil moisture or other factors.

In other areas where, even if green fodder or padi straw is available for cattle, &c., there is a dearth of other foods necessary to balance the animal diet in order to improve their economic value. Thus, oil cake, roots or carbohydrates may be in short supply or too expensive to utilize as animal foodstuffs.

It is amazing, however, how animals adapt themselves to available conditions and thrive so well despite apparent lack of balance in their food supplies. The water buffalo thrives remarkably well on tough rice straw which is often abundant for some months annually and is sometimes stored for fodder. Other cattle fend largely for themselves on the sparse grasses available between rice seasons and on the fodder to be found along road sides, villages, &c., sometimes eked out with rice congee and other sources of carbohydrate.

In wet zones, pigs thrive surprisingly on a diet too largely composed of 'kangkong' (Ipomoea aquatica) and bolstered up with tapioca refuse, sweet potatoes and a little rice bran. Poultry mainly live on what they can find, supplemented by the leavings of the peasant farmers' daily meal of rice, while ducks feed fairly well in the rice season.

By and large, however, only a very small percentage of the livestock in the region is provided systematically with an adequate and balanced food supply, the large remainder of the livestock exists on a diet which is inadequate as well as nutritionally unbalanced. However, efforts have been made periodically to provide reliable information towards the better feeding of livestock in the general absence of suitable pasturage in this region.

One of the outstanding contributions to our knowledge of fodders and feeding stuffs in this region is the work of Georgi in Malaya in 1934 (1). He outlined the basic principles underlying feeding and the compilation of rations on scientific lines, provided data showing the composition of recognized available food stuffs and their digestibility and nutritive values and he suggested typical balanced daily rations of local practical utility for cows in milk and for pigs.

His table of the composition of fodders and foodstuffs forms a useful reference and from it, the analyses of the grasses, shown in Table I are derived.

TABLE I

Fodder, Grasses, &c.

		Moisture	*Crude Protein*	*Crude Fat*	*N.F. Extract*	*Crude Fibre*	*Ash*	
Guinea	Pan Maximum	78	5·5	0·2	7·6	5·3	4·4	Cut weekly
Guinea	Pan Maximum	77	3·4	·2	8·7	6·4	4·3	Cut 3-weekly
Guinea	Pan Maximum	75	2·5	·2	11·2	8·2	2·9	Just before flowers
Mauritius	Pan Muticum	74	1·8	·3	13·0	7·9	3·0	Just before flowers
Merker	Penn. Merkeri	85·5	1·8	·4	5·4	5·0	1·9	Just before flowers
Napier	Penn. Purpureum	83·8	2·6	·3	6·3	4·7	2·3	Just before flowers
Carpet	Axon Compressus	76·9	2·8	·2	11·5	6·8	1·8	Just before flowers
Dallis	Pasp. dilatatum	74·2	2·4	·2	11·2	9·4	2·6	In flower
Lalang	Imp. Arundin.	74·7	3·7	·5	10·8	8·7	1·6	Just before flowers
Cowpea	Vigna Catjang	88·9	3·4	·2	3·2	2·7	1·6	Just before flowers
Sweet Pot.	Impomoea bat	86·7	2·5	·3	6·5	2·5	1·5	Just before flowers
Water Hac.	Eichomia cras.	94·1	1·0	·1	2·4	1·2	1·2	Just before flowers
Keladi	Colocasia nymph	92·3	1·3	·3	3·9	1·3	·9	Just before flowers
Banana stems	Musa	94·9	·2	·1	3·6	·9	·3	Just before flowers

Table from Georgi - Gen. Series No. 17—1934 Malaya.

A further valuable contribution to our knowledge of local grasses is the interesting article on the reactions of Guinea grass to manurial applications published by Greenstreet and Greig in 1933 (2). In that article it is shown that, for Guinea grass, the fibre content of the foliage does not vary with the increase in age of the stools or with differing manurial treatments ; the decrease of crude protein occurs with increasing age of the stools ; but that there is no difference in protein content between cuttings at 2-week and 3-week intervals ; that decrease in protein content of the grass does not vary with manurial treatment and that decrease in protein content with age is less in light soils than in heavy soils. It was further shown that the application of 15 tons of farmyard manure per acre per annum produced a crop of 100 lbs. of cut grass daily for 5 years with 4-weekly cuttings irrespective of the distance of planting of the grass within the limits of 6,000 and 10,000 plants per acre, but this yield appears low compared with more modern work. Basic slag gave the most satisfactory results as a manure from the economic aspect and, generally, artificials gave better results than organic manure. When signs of deterioration of crop became obvious, that is after 3–4 years, replanting the crop was recommended. These results were confirmed in 1938 (3) after comprehensive experiments.

In regard to Napier grass (Pennisetum purpureum) a most practical article dealing with periodic cuttings and their effects on the nutritive value of the crop as a fodder was more recently

contributed by Patterson working in Trinidad (4). Working on cuttings taken in 4, 8 and 12-weekly periods he concluded that the longer the period between cuttings, the higher the yield of crop per acre both of green herbage and of dry matter. His percentage figures were as follows compared with 12-weekly cuttings (=100):—

4-weekly cuttings ..	56·5% herbage ..	39·2% dry matter
8-weekly cuttings ..	83·7% herbage ..	65·4% dry matter
12-weekly cuttings ..	100 % herbage ..	100 % dry matter

He found that 4-weekly cuttings resulted in a smaller root system, a less virile stool, less vitality in the grass and ultimately a high mortality in the individual stools. In nutritive value the average grade green fodder is equivalent to medium quality English meadow hay but lower in protein content—even 4-weekly cuttings show lower protein content. The percentage of dry matter, crude protein and ash vary immensely with the rainfall. In wet weather, dry matter, protein and ash tend to fall while fibre percentage tends to increase. Thus, the nutritive value of the grass per unit weight of herbage is lowest while the crop is growing the more vigorously. He decided, therefore, that 12-weekly cuttings were distinctly more advantageous than shorter periods because they ga e much higher yields of green fodder and of crude protein per acre and the decrease in nutritive value, when compared with younger herbage was not excessive, while the rice in rude fibre was not so great as to lower unduly the digestibility when fed to stock. 12-weekly cuttings also favoured hea'thiness of the stools and their longevity—the larger root system induces greater productivity and renders the crop less susceptible to weed competition.

In Hawaii, Napier and Guinea grasses were found to be approximately equal in palatability and in milk production. Palatability varied with the age of the grass and cattle would only eat the coarse stems when they were chopped in an ensilage cutter. Yields of Napier grass averaged 70 tons per acre per annum with five cuttings per annum, though under intensive manuring yields up to 87 tons per acre were recorded.

Experiment in Hawaii indicate that there is a good future for mechanized harvesting of Napier grass on economic grounds, using either trail type harvesting or a self-propelled forage harvester. It is stated that harvesting a crop of 5,000 tons of fodder a year, the cost per ton amounts to $3·40 by hand harvesting, $1·06 using trail harvester chopper and $1·28 using a self-propelled forage harvester, although the capital cost of the last-named machine is about double that of the trail harvester chopped.

It may be of interest, as a corollory to the preceding notes on Napier grass, to record the analysis of this grass, cut at varying periods. Accordingly, Table II, prepared by the courtesy of the Chief Chemist of the Department of Chemistry, Singapore, indicates changes in composition of Napier grass similar to those already recorded for Guinea grass, when cut at periods of two up to five weeks.

TABLE II

Analyses of Napier Grass

Cut at Intervals of	*Percentages*				
	Moisture	*Crude Protein*	*Crude Fibre*	*Ash*	*Fats*
15 days	86·2	3·06	2·96	1·94	·24
21 days	85·3	2·63	3·60	1·70	·15
28 days	85·9	2·01	3·64	1·17	·19
36 days	86·7	1·75	3·76	1·02	·13

The Table shows an obvious increase in the percentage of crude fibre with increase in the periods between the cuttings of the grass, while the crude protein, ash and fat percentage show a steady decline. Unfortunately, the analyses of the grass when cut at longer intervals than five weeks are not immediately available but such further analyses will be provided in the near future as a continuation of the results given in Table II, in an attempt to assess the most economic grass cutting periods when consideration is given to all aspects including nutritional value, quantity of fodder per acre per annum and handling costs, &c.

Judging from much experience gained in Singapore there seems little doubt that Napier grass gives the heaviest return of fodder per acre per annum when generously supplied with farmyard and artificial manures. The Singapore Dairy Farm (5) reckons on returns of 60-70 tons per acre per annum of green fodder from this grass on quartzite soil when cut at 4-6 week intervals and manured after each cutting with about 3 tons of farmyard manure (or more if available, aiming at 45 tons per acre per annum) and that this rate of yield is steadily maintained. So far there have been no signs of deterioration of this production or that rest and replanting would be beneficial. Napier grass is the basis of stall feeding for all the cows on the farm, each cow consuming 80 lb. daily. Naturally, yields vary with seasonal rainfall and it may be mentioned that the best yield per acre per annum recorded on this farm has been 106 tons.

Yields from Guinea on the same farm and under the same conditions of cutting and manuring are estimated at some 20-25 tons per acre per annum and Guinea grass stools are observed to deteriorate in healthiness and yield at an earlier age than with Napier grass. In the Federation of Malaya, yields up to 40 tons of Guinea grass per acre per annum have been obtained.

Staff feeding, however, under existing hand cutting conditions is expensive and hence, latterly more attention is being given to the potentialities of developing grazing grasses especially in conjunction with the more modern ideas on cattle raising in the tropics. These ideas trend towards the utilisation of livestock of tropical origin as being best fitted for tropical environment and likely to be the most economically productive in the long run. With such cattle, in particular, there is no doubt that their maintenance in health is easier to achieve than with cattle imported from temperate or semi-temperate climates and, although average milk yields are comparatively low, cattle suited to the tropics tend, on the average, to show more economic returns, though the reverse effect has sometimes been achieved through the higher milk yields obtainable under intensive management as in some dairies in Hong Kong and Singapore. However, modern scientific dairying is still in its infancy in much of South-East Asia, though markedly successful already in some areas.

In regard to pasturage Lancaster (6) in his Annual Report for 1940 states that the provision of adequate grazing and pasturage for cattle is a major problem since many so called grazing areas in Malaya are merely weed infested and grossly neglected patches of coarse grasses that have never been given any cultural or manurial attention and have been exploited by cattle owners rather than grazed.

During the past fifteen or twenty years the position has worsened as the result of the invasion of the northern part of the Peninsula, particularly on the western side, by the composite shrub *Eupatorium oderatum* (" pokok kapal terbang ") which appears to have entered from the southern part of Thailand. This weed, which is shunned by all forms of livestock and for which no use has yet been found, has taken control over many forest clearings, roadsides, bunds and grazing reserves that were formerly available as sources of pasturage for cattle and has, by suppressing the growth of the indigenous grasses rendered them useless for cattle grazing. The total acreage, thus rendered useless is considerable and the spread of this weed southwards through Kedah

Perak and Selangor has been persistent and insidious. It requires the most vigorous measures for its check but to date no satisfactory and economical method for its elimination from grazing areas has yet been evolved and until one is found it will continue to militate seriously against the nutritional side of animal husbandry.

Efforts are, however, now being made to improve grazing grounds and some thousands of acres of grazing lands have been fenced with a view to their improvement by recognized modern methods which include rotational grazing, liming, top dressing cultivation, replanting with suitable grazing grasses, or which there is much scope for selection a matter now being given attention by the Department of Agriculture.

Observations of many years, recently recorded by Jagoe (7) show that the beneficial effects of some leguminous shade trees on grassland in Malaya can be very marked and states that the primary essential factor in the extension of cattle raising in this region is the provision of better quality grazing areas than are now generally available and their consistent maintenance and improvement. He recorded that 'Savannah' grass (Axonopus compressus—also known as broad leafed carpet-grass) a useful grazing grass, developed strongly in the shade of 'Rain' trees (Enterolobium saman) with their wide spreading and not too dense canopies and produced stronger growth and better quality grass than that growing in full exposure to the sun, in the wet tropical climate of Malaya where soils often suffer severely from leaching of nutrients.

He showed that the protein content of Savannah grass (14 per cent.) growing under 'Rain' and other leguminous shade trees, was appreciably higher than when the grass was growing under non-leguminous trees for which he found an average protein content of 11·60 per cent. or under oil palm trees when the protein content was even less (9·56 per cent). These figures are less than those for good pasture grass growing in temperate climates (about 17·0 per cent.) but they are significant of the considerable advantage of light shade in the production of good quality grazing grass.

His observations also showed that, whenever conditions were favourable, this grass with its stoloniferous habit, is able to suppress or supercede coarser grasses, including even "lalang" (Imperata cylindrica) if cut or reasonably grazed. Hence, he concluded that for the production of good grazing grass it would be highly advantageous if grazing areas were planted with suitable leguminous shade trees at widely spaced intervals and recommended intervals of 100 feet. The 'Rain' tree, in suitable conditions will cover some 70 × 70 feet within 20 years—smaller trees, it was suggested, (such as Gliricidea maculata) could be interplanted and removed later as 'Rain' trees expanded their shade. These observations reveal much scope for research in the production of good grazing areas and the laying down of pastures and hence, merit early consideration.

Jones (8) after convincing experiments and demonstrations showed that the onus was really on the farmer, under average conditions in a temperate climate, to produce whatever kind of sward desired by good scientific management. He showed that over grazing or over cutting the sward markedly restricted the development of the root system and of the succulent leaf base, both in young and in old established swards and that growth and production of green leaf was greatest when the grazing or the cutting had been lenient such as would be the case under rotation grazing.

He also showed (9) that although introgenous dressings approximately doubled the actual yield of fodder, during early periods of grazing provided adequate phosphate was available in the soil it had relatively little influence on the botanical composition of the sward. On the other hand, the time and intensity of grazing markedly affected the botanical composition of the sward in relation both to the proportion of grasses and clovers and to the inroad of weed grasses and other weeds, thus governing the improvement or deterioration of the sward.

His experimental conclusions were much utilized in practice with substantial economic results and paved the way for further advances in the laying down of pastures and in the maintenance of their fertility and their value to the farmer.

It has been shown by many workers in the past 30 years, that the seeds mixture used in temperate climates, combined with the fetilizers applied and the grazing management, play an important part in determining the type of sward that is developed. While considerable research in the isolation of pedigree strains of grasses has been done in Europe, practically nothing has yet been done in this direction in South-East Asia, where no doubt future work will indicate a wide range of variation in productive capacity in different strains of grasses suitable for grazing or for stall feeding.

The type of sward also effects the condition of the soil and yield of crop under rotation as shown by Davies (10). The land is the factory in any farming system, quite apart from grazing alone, and hence, soil fertility must always be maintained ; towards this end well managed grasslands play an essential and very important part since the sward promotes ' crumb ' structure in the soil better than any other crop and so makes cultivation easier.

In good mixed farming or in dairy farming it has become increasing evident in the past few decades that good grass is of very considerable economic value and must be treated as any other economic crop if the best results are to be achieved, rather than as a mere grazing area. Grasslands must be drained, cultivated, manured, weeded and grazed or cut in regular rotation and maintained in the best possible condition at all times in order to attain their utmost utility as the basis of mixed farming and to provide the highest economic returns from the farm.

It is hoped that these notes may prove of interest and serve to direct more attention to the need for the study of the economics of the production of fodder for livestock, whether they are stall fed or permitted to graze on suitable pastures since the future of livestock depends so largely on good and adequate fodder supplies, and it is so highly desirable that livestock should be enabled to thrive healthily and increase considerably in numbers for the general welfare of every community in South-East Asia.

REFERENCES

1. Fodders and Feeding Stuffs in Malaya by C. D. V. Georgi, Bulletin No. 17 (General Series), Department of Agriculture, Federation of Malaya, 1934.
2. Manurial Experiments with Guinea Grass at Serdang—Greenstreet & Greig—Malayan Agricultural Journal, Vol. 21, No. 11, 1933.
3. Ditto—Vol. 26, No. 1938.
4. ' Napier Grass '—World Crops, Vol. 2, No. 9, 1950.
5. Singapore Dairy Farm—Unpublished records, 1950.
6. Annual Report of the Veterinary Department of the Federation of Malaya for 1949 by W. E. Lancaster.
7. Beneficial Effects of some Leguminous Shade Trees on Grassland in Malaya, by R. B. Jagoe, Malayan Agricultural Journal, Vol. 32, No. 2, 1949.
8. Grassland Management and its influence on the Sward, by M. G. Jones—Empire Journal of Experimental Agriculture, Vol. 1, No. 1, 1933.
9. Ditto—Vol. 1, No. 2, 1933.
10. Grassland Agronomy by W. Davies—New Biology, No. 6, Penguin Series.

October, 1950.

H. W. JACK,

Agricultural Adviser to the Commissioner-General for the United Kingdom in S. E. A.

PROCEEDINGS OF THE EIGHTH MEETING OF THE CENTRAL BOARD OF AGRICULTURE HELD IN THE BOARD ROOM AT THE ROYAL BOTANIC GARDENS, PERADENIYA, ON DECEMBER 4, 1950, AT 2 P.M.

DR. A. W. R. Joachim (Acting Director of Agriculture), presided, and the following were present:—Mr. T. M. Z. Mahamooth (Deputy Director, Animal Husbandry and Government Veterinary Surgeon); Mr. C. A. M. de Silva (Vice Chairman, C. B. A.); Mr. A. Hensman; Dr. W. R. C. Paul (Principal, School of Agriculture, Peradeniya); A. E. Madawala Dissawa; Mudaliyar N. M. Abulcassim Maraikar; Mr. W. P. A. Wickremasinghe, M.P.; Mr. A. M. Clement Dias; Mr. A. L. Johnpulle (Divisional Agricultural Officer, Uva); Mr. K. W. Devanayagam; Mr. E. Muttukumaru; Mr. H. Abeyagoonesekera; Mr. S. L. Bandara Dharmakirti, J.P.; Major E. C. de Fonseka, M.B.E., E.D.; Mr. R. T. Chelliah; Mr. R. H. Spencer Schrader; Mr. Marcus S. Rockwood; Mr. B. F. Perera (Director, Rural Development); Senator Justin Kotelawala; Sir Wilfred de Soysa; Rev. Fr. L. W. Wickremasinghe; Mr. Thomas Amarasuriya (Chairman, Low Country Products' Association); Mr. S. C. Fernando (Registrar of Co-operative Societies); T. B. Poholiyadde Dissawa, M.P., J.P.; Mr. U. B. Unamboowe; Hon'ble Mr. H. W. Amarasuriya (Minister for Commerce and Trade); Sir James P. Obeysekere ; Dr. M. F. Chandraratne (Botanist and Senior Agricultural Research Officer); Mr. F. C. Cooke (Director, Coconut Research Scheme); Gate Mudaliyar N. Wickremaratne; and Mr. R. L. Arnolda, C.C.S. (Secretary, Central Board of Agriculture).

The following visitors were also present:—Mr. J. M. Thomason (Agricultural Adviser to the Ceylon Government); Mr. M. Srikhanta (Director, Land Development); Mr. R. B. Thalakada (Assistant Registrar, Co-operative Societies).

Letters and telegrams regretting inability to attend the meeting were received from the following members:—Mr. Wilmot A. Perera, M.P.; Dissawa S. A. I. Elapata; Director, Tea Research Institute; Director, Rubber Research Scheme; Mr. W. M. Cumaraswamy; Mr. S. Sivapalan, M.P.; Mr. E. Abeyratne (Agricultural Research Officer, Maha Illuppalama); Gate Mudaliyar M. S. Kariapper, J.P., U.M., M.P.; Mr. A. Perumynar; Mr. R. Singleton Salmon (Deputy Chairman, Planters' Association of Ceylon); Mr. U. B. Dedigama; and Director of Irrigation.

I—WELCOME TO NEW CHAIRMAN AND SECRETARY

Mudaliyar N. M. Abulcassim Maraikar—" Gentlemen, before we proceed with the meeting, I crave the indulgence of the House and request the Chairman to permit me to perform a very pleasing duty and that is to welcome our new Chairman to the Central Board of Agriculture. I also could see another new face seated by his side and that is the Assistant Director of Agriculture (Administration), Mr. Arnolda. He is the Secretary of the Central Board of Agriculture today. Gentlemen, we knew our Chairman Dr. Joachim for a long time. He has been wedded to the Department of Agriculture for several years and he has undergone a rigorous course of training in matters pertaining to agriculture and I am sure his mature knowledge and ripe experience will stand in good stead in conducting the affairs and guiding the destinies of the Central Board of Agriculture of which he is the Chairman today.

" It is also really gratifying to note that the Assistant Director (Administration) who has had considerable experience in provincial administration has been sent here to be the Secretary of this Board. We all know that in any Association or Board the Secretary is the live wire of that Board or Association and I have no doubt that Mr. Arnolda with his knowledge of administration will prove an efficient Secretary to the Central Board of Agriculture. I do not want to stand in your way gentlemen, to say something more of this young Secretary of the Board. He has come here with a great reputation as one of the ablest Assistant Government Agents today in Ceylon. He has no doubt maintained

the tradition of the Civil Service and has worked in keeping with the traditions of Sri Lanka which we are now enjoying. There is one thing I do not want to omit, gentlemen, and that is our Secretary is a very sympathetic person, most amiable and he has got most attractive qualities which I am sure will all combine to bring about success in the deliberations of this Board and in the Department of Agriculture."

Mr. C. A. M. de Silva—" I have great pleasure in seconding this welcome that has been expressed by the last speaker."

Chairman—" Gentlemen, thank you very much for the very kind words which were spoken by Mudaliyar Abulcassim Maraikar on behalf of myself and the new Secretary Mr. Arnolda. I can assure you that on my part I shall always rely on the full co-operation of this Board in determining the future concerning agricultural interests of this Island. I consider that a Board is appointed for the object of giving necessary advice on matters with which it is best competent to deal, and as far as I am concerned, it shall always be my duty and always be a great pleasure to me to record the decisions you make at these meetings and to convey them in due course to the Authorities who finally adjudge all these matters and I am sure they will follow your recommendations. I thank you very much on behalf of Mr. Arnolda and myself for the very kind words with which you have welcomed us."

II—CONFIRMATION OF THE MINUTES OF THE LAST MEETING

The minutes of the 7th meeting of the Central Board were unanimously confirmed as correct.

III—MATTERS ARISING OUT OF THE MINUTES

Arising out of the minutes of the last meeting, Mr. C. A. M. de Silva said that a deputation of the Board had gone before the Minister of Agriculture to retain the services of Mr. Rhind. That deputation had met the Minister and had placed certain facts before him at the request of the Board. One question that deputation asked the Minister was whether Mr. Rhind was to be replaced by a new recruit from abroad or by a Ceylonese. When the Minister gave the assurance to the deputation that his place would be filled by a Ceylonese, the deputation had no alternative but to agree with that principle and they were all glad to have Dr. Joachim as Head of the Agricultural Department. Dr. Joachim has served the Department for very nearly three decades and at the time he joined the Department he (Mr. de Silva) was a member of the Board (about the year 1922) and there are just a few in the Board who have been serving on the Board from that time. In conclusion he said that the Minister was very frank in his dealings with the deputation and they were glad that Dr. Joachim has been selected to succeed Mr. Rhind.

Gate Mudaliyar Wickremaratne said that he had left the last meeting of the Board before it was over and had read in the papers the next day that a deputation was waiting on the Minister to retain the services of Mr. Rhind. He emphasised that he did not agree with that deputation and had written to the Board as well as the Minister dissociating himself with the activities of that deputation.

At this stage the Chairman observed that the Board was within its rights to have appointed a deputation to interview the Minister since a majority of the members felt that Mr. Rhind's services should be retained.

IV—DISCUSSIONS

Next item on the agenda was for Gate Mudaliyar N. Wickremaratne to initiate discussions on the following:—

(*a*) Whether the members of this Board could suggest ways and means of helping the C. A. P & S. S. to be more useful in the increased production of food in rural areas.

(*b*) Consider ways and means of making use of existing cattle in the villages to produce milk and milk products through Co-operative Dairy Societies.

Gate Mudaliyar Wickremaratne felt that the C. A. P. & S. Societies were not doing enough to increase the production of food in the rural areas. He said that it was evident from newspapers that large quantities of foodstuffs and curry stuffs were being imported daily from India and other countries and that these imports were increasing daily. He said that as the population was increasing the imports were also increasing. Although no proper statistics were available on the increase in food production, he was sure that the country was not keeping pace with the increase in population and the increased demand for food and that no proper statistics were kept of the increased production of food. But without statistics he could say that they were not doing enough to produce local food for the consumption of the people of this country. He also regretted to observe the remarks made by a certain Minister as to how steps should be taken to prevent the increase in population. He remarked that that was the last thing a human being least of all in this country should think of. The remedy was not to prevent the increase in population but to increase food production. Co-operative Schemes and Societies were primarily started in this country in order to help the cultivator to increase food production and then the Co-operative Scheme was really under the Department of Agriculture. Sufficient co-operation was not forthcoming from the then Additional Registrar of Co-operative Societies to help the technical Director of Agriculture in promoting this movement and at last the Co-operative Societies were separated from the Department of Agriculture. He explained briefly how the Co-operative Scheme came into being and how the Ceylon Agricultural Society was interested in the promotion of food production through co-operation. He also related how he could not agree that the Co-operative Scheme should be separated from the Department of Agriculture and how he told the Minister that he would leave the Department in such an event. He also referred to the old Co-operative Ordinance and the preamble to it which explained the purpose of the Co-operative movement which indicated that this movement was started in order to encourage co-operation among agriculturists and particularly to help agriculturists of limited means in their efforts to produce food. He emphasised that the contents of that preamble has altogether been removed from the present Ordinance that has been passed. He said that although Co-operative Societies were separated from the Agricultural Department now they have come back to the Agricultural Department in connection with food. It was his feeling that the Co-operative Department was taking more interest in the distribution of food than in helping the agriculturists. When the " new Minister " was appointed to encourage co-operation and also the distribution and production of food, Mudaliyar Wickremaratne had written to the Minister suggesting what should be done to help the agriculturist more than the mere distribution of food. But this new Minister started a new kind of Society called the Co-operative Agricultural Production and Sales' Societies. Agricultural production was a good idea but he could not see what steps have been taken to help the agriculturists in their requirements and at the end of the harvest to see that their produce was sold. It is a very good idea but whether it is really fulfilling the object is a matter for the members of the Board to see and if it is not, to remedy them. He was not going to move a resolution on this matter but he was only asking the members in what way they could recast or re-arrange these Societies in such a way as to make them produce more food. He had understood that the Co-operative Agricultural Production and Sales' Societies were not managed, supervised or controlled only by the Registrar of Co-operative Societies but according to rules passed by him it was the Registrar who had to sanction whatever is applied for by agriculturists with a recommendation from either the Government Agent or the District Revenue Officer. He felt that the real object of those Societies could not be fulfilled with such requirements as members could not readily obtain such recommendations. He also emphasised that it should not be the responsibility of the Registrar alone to help such members with raw material, implements, &c., and that other officers should also be authorized to do so. He wondered whether any of the members present at the meeting had gone into that question and if so he would be glad to have their experiences.

The next question he wished to ascertain was whether those Societies were fulfilling the real object for which they have been formed. In his opinion the area of operation of those Societies was too large, and if those Societies were to help members more effectively the area of operation should be reduced to two villages or one, if the village is a large one. But it was his belief that in certain cases one Society had to serve a whole Chief

Headman's Division. That was too big an area to be worked. Therefore he inquired whether those Co-operative Agricultural Products and Sales' Societies should not be recast in order to serve smaller areas.

The third question he would like to stress was that the proper way of production and distribution of food should be brought to the notice of all concerned. When food is produced by a Society it should not be allowed to leave the district unless it is verified that the requirements of that particular district in that commodity has been fulfilled and is self sufficient in that commodity. It was his experience that certain paddy producing areas transported all their produce outside their district and large quantities of imported rice were sent back to the district. That was a highly unsatisfactory state of distribution. He therefore requested the authorities concerned to see that only the surplus produce of a district was transported outside that district. As a solution to this difficulty he suggested that C. A. P. & S. Societies in a district should have their own store and when the produce is collected they could see to the requirements of the district and dispose of the surplus. He hoped that members of the Board who are acquainted with this subject and officers of Departments who know the subject would give their help in this direction. He also briefly explained how certain Co-operative Stores Societies were mismanaged and how a number of irregularities have been brought to light. He said that in the former days each consumer's requirements for a month or week were estimated and ordered from the Wholesale Distributor and only a nominal amount was charged for handling expenses, &c

Honourable Mr. H. W. Amarasuriya, Minister for Trade and Commerce, said that a very useful memorandum had been submitted on the work of C. A. P. & S. Societies in food production and that if there were any helpful contributions the Board could make, it would serve the purpose of that discussion.

Commenting on the remarks made by Gate Mudaliyar Wickremaratne, Mr. S. C. Fernando, Registrar of Co-operative Societies, explained how it was necessary for several departments to associate in the work of the Sales Societies. He said that the Land Department had to come in because it is primarily their responsibility for the distribution of land and planting material and funds were in their charge, and the supervision was carried out by Revenue Officers. The three Departments including the Rural Development have been working quite harmoniously and they in fact had Liaison Officers appointed to go from one Department to another and settle any problems that arose, on the spot. He said that each of those Departments had to come in as they had different functions to perform but the legitimate activities of the Co-operative Department which came under the Ordinance were looked into and attended to by the Co-operative Department. He could assure the Board that wherever technical advice from the Agricultural Department was wanted it has been obtained and there had been no friction or difficulty in that respect and he had always received the co-operation of Agricultural Officers and other officers. Regarding Mudaliyar Wickremaratne's remark, that the area of operation of some of these societies was too large, he would like to inform the Mudaliyar that it was uneconomic and wasteful to have a number of small units when it came to a question of transport and overheads, and larger units were necessary in the interests of efficient functioning. He said that in the Eastern Province a certain Agricultural Production and Sales' Society had bought a tractor for Rs. 20,000 and stressed that only big societies could go in for such expensive items. With regard to the question of transport, he said that wasteful transport was now avoided as far as possible and that the practice of transporting country rice or paddy from producing areas to milling areas or to Colombo, whilst coupon rice was sent to supply the needs of the same areas was being discontinued. Now, instead, the requirements of the people of the area were met as far as possible and if there were any surplus left, it would be transported elsewhere. He said that it was evident from Mr. Srikhanta's report that over 300 Co-operative Agricultural Production and Sales' Societies have been organized and he could assure Mudaliyar Wickremaratne that with demonstrations to members and lectures on new methods of cultivation with the co-operation of the Department of Agriculture they would be able to step up production gradually and ease the food situation to a great extent. He said in conclusion that particularly in the Eastern Province, thousands and thousands of acres have been cultivated under the guidance of these societies and it was one notable aspect of the work done by these C. A. P. & S. Societies that large extents hitherto abandoned owing to

depredations of wild animals were being brought under the plough after barbed wire had been made available. Ploughs and other implements, manure and other loans in kind were also serving as a great stimulus.

Senator Justin Kotelawala in associating himself with the discussion initiated by Gate Mudaliyar Wickremaratne said that he would first congratulate the Mudaliyar for bringing up such a motion before the Board because it afforded members to contribute some suggestions for the welfare of this country. He said he had also a suggestion and did not know how the members would look at it. He had read sometime back that Soya bean was one of the best foods in the world. He had himself tried the cultivation of this bean and it was evident that it could be grown in this country and he had found that it was quite palatable. He therefore felt that if Soya bean, curd, and " mellun " could be encouraged into the normal diet of the people, a healthy nation could be built of our people. He also suggested that experiments should be conducted in the preparation of various dishes out of Soya bean and the people should be taught to prepare them. He recommended the appointment of a sub-Committee to go into this question.

Mr. M. Srikhanta, Director, Land Development, spoke next explaining the functions of the C. A. P. & S. Societies and commenting on the remarks made by Gate Mudaliyar Wickremaratne. Referring to a remark by Mudaliyar Wickremaratne that more than one Department is in charge of the C. A. P. & S. Societies, he emphasised that it was necessary for a number of Departments to co-operate and in turn to get the co-operation of people to make the scheme a success. This has been realized by Government and that was why for the food production drive the District Agricultural Committees had also to contribute and if the composition of the District Agricultural Committees is examined, it will be realized that the Co-operative Department, Agricultural Department and various other Departments are represented as well as coconut interests and so on, including members of Parliament. That is because Government wishes to have the co-operation of the various Government and other organizations who are primarily interested in the production of food. Now as far as we can see Government policy is to stimulate production by giving an assured price to the cultivator and to make facilities available to him to market his produce and at the same time to make available to him the instruments of production through the Co-operative Societies.

C. A. P. & S. Societies were started about 4 years ago and he has made reference in his memorandum (circulated to members of the Board) to the method of granting loans. There are short-term and long-term loans granted to these societies. Short-term loans are repayable within 12 months. Long-term loans such as planting material, barbed wire and practically everything that the cultivator needs is being provided by these C. A. P. & S. Societies, repayable within longer periods. They have already issued 850,000 tons of barbed wire and about half of this has been given to the North-Central Province. Whether the Agricultural Department has started a system of developing villages or whether the Rural Development Department is doing that work, this barbed wire is used by the villagers for perimeter fences to protect their crops from damage by cattle. They have also supplied pumps to cultivators for irrigating their crops in every district who have applied for them and particularly the Jaffna District. There was also a move recently to exempt from customs duty, agricultural implements needed by C. A. P. & S. Societies. He said, however, that it was too early to confirm this as no finality has been reached officially. These have to be ordered through the Government Stores where Departmental charges would be added and the C. A. P. & S. Societies would get them at the cheapest possible price. In regard to the other point raised by Gate Mudaliyar Wickremaratne that the area of operation was too large, he said that the Registrar has already explained why it should be so.

Regarding the question of storage, about which they were much concerned, there were two proposals under consideration. One was, they have already sanctioned a large number of loans for the construction of godowns—5, 10 and 15 thousands. At the same time they were exploring the possibility of large godowns at their departmental buildings. They hope to store the seed paddy required for each year as far as possible and meet the demands made by cultivators of C. A. P. & S. Societies. Items enumerated in page 3 of the memorandum are further assistance proposed for C. A. P. & S. Societies and were well under consideration and they hoped to arrive at an early settlement.

There was one other very happy feature of the scheme which he would comment on. Although some had taken the pessimistic view that Government would not recover the money it had loaned through these societies, he was happy to say that with one or two exceptions, repayments have been very prompt. Out of 20 million rupees so far advanced to C. A. P. & S. Societies something like 8 millions have been recovered and most of the balance had been advanced only recently. He concluded that this was a very encouraging feature of the C. A. P. & S. Societies.

Mr. K. W. Devanayagam said that those societies were organized in order to help the poor farmer who is generally absolutely poor and had no capital. The Land Development Department was issuing seed paddy on loan to these cultivators but suddenly this was stopped and he was not aware of the reasons. He believed that this has been done apparently on the principle that a farmer should primarily be concerned with conserving seed paddy for use. He has no means of preserving seed paddy because his means were so small. If one could really analyse the position of the average farmer it would be evident that he does not cultivate more than 5 or 6 acres. Normally he does everything in order to prepare the land efficiently for cultivation but he has not got the seed paddy. He felt that these societies were of no use if they could not help in such a situation. He suggested that the Land Development Department should buy seed paddy from the farmers and when cultivation begins the seed should be issued to farmers on loan.

Mr. Srikhanta, Director, Land Development, in reply stated that seed paddy was partly covered by the schedule of purposes for which loans were given.

Honourable Mr. Amarasuriya inquired whether the schedule covered the Eastern Province as well and if so the previous speaker had no cause for complaint. He added that in view of the excellent memorandum that had been tabled which explained the good work the C. A. P. & S. Societies were doing at the moment, the other point was whether as members of the Board they could give suggestions to improve the good work those societies were doing. The fact that there were 311 societies was testimony to the fact that they were serving a useful purpose and were functioning well and he wished if there were more. He believed that the Department concerned was a bit cautious in expanding their activities as they do not have sufficient staff to cope with the work. He said he would like to see further stimulus given to the Department to cover the whole Island as soon as possible. At the slow pace they were going it would take decades to do so.

Mr. Marcus S. Rockwood said that Inspectors who go round estates distributing forms for collecting information about crops grown during Maha come for the information only during the next Yala and they depend on the word of the producer who invariably is not correct.

Gate Mudaliyar Wickremaratne pointed out that that was a different subject and had no connection with the matter under discussion.

Mr. Marcus S. Rockwood said that he was only going to show that the supervision of those officers responsible for collecting the information was inefficient in that the information was not collected at the proper time, so that if they were to increase production and supply sales societies, the type of supervision would have to be altered and made more effective.

The Chairman observed that that was not relevant to the discussion.

Mr. Srikhanta, Director, Land Development, spoke on the points raised by a previous speaker about issue of seed paddy. He said that the issue of seed paddy was governed by certain rules. Seed paddy was normally issued in times of destruction of crops by drought or during a time of successive failure of crops. Pureline seed paddy was issued on a large scale by the Agricultural Department but in other cases the normal rules that governed the issue had to be followed and should be the same for all parts of the Island. The difficulties they were confronted with were that some applicants were members of those C. A. P. & S. Societies while others were non-members. The difficulty in the Batticaloa District was that although the money was applied for seed paddy, it was really expenses for cultivation. He believed that Mr. Devanayagam would be satisfied that Government was actually using this seed for various cultivation operations. He said that if the suggestion

to form a Union of the C. A. P. & S. Societies to reserve all the seed paddy required was approved by Government, it would come into force from 1951-52, and then an adequate supply of seed paddy on loan could be assured for proper utilization.

In regard to the point raised by the Minister of Commerce and Trade, Mr. Srikhanta said that the Minister would be glad to know that C. A. P. & S. Societies were functioning in all provinces of the Island. North-Western, Northern and Eastern Provinces were all covered by C. A. P. & S. Societies and a few of the areas covered by those societies were non-surplus areas. In the surplus areas it was proposed that the Stores' Union should be given loans to purchase the surplus produce. It should be possible for any cultivator to sell his produce either to the C. A. P. & S. Society or to the Union at the guaranteed price. In conclusion he said that in addition to the 311 societies mentioned in the memorandum there were a number of societies which were yet to be registered. In regard to the question raised by Mr. Marcus S. Rockwood about the food production on estates, he said he would not make any comments since the Food Production (Estates) Department was quite different from his Department.

Sir Wilfred de Soysa next spoke at length of what he had seen in his travels when he visited Ireland recently. He had visited a number of dairying institutes and farms and he believed that the work performed by those institutes would be useful to this country and he promised to submit a memorandum to the Board at the next meeting.

Mr. E. Muttukumaru said that in regard to these societies, there was only one little difficulty and that was the necessity for adequate supervision. There were leakages from these societies and in estate areas where there were large estate owners, he felt, that much could be done in the way of preventing such leakages. He also felt that members of the Board and members of District Agricultural Committees could do a lot to increase production of food in rural areas only if they could take a more practical view of things, and visited the areas themselves and discussed ways and means of increasing food production. In conclusion he said he would move a resolution " Expressing the Board's satisfaction of the work of the Government Departments concerned in Co-operative Agricultural Production and Sales' Societies ".

Mudaliyar Abulcassim Maraikar in seconding the resolution moved by Mr. Muttukumaru said that he entirely agreed with the views expressed by him and could endorse all what he said about Co-operative Agricultural Production and Sales' Societies since he (Mudaliyar Maraikar) was aware of the working of those societies, being President of the society in his area.

At this stage Gate Mudaliyar Wickremaratne raised an objection that the resolution appreciating the work of the societies was out of place and was not relevant to the discussion.

The Chairman however felt that since it was the wish of the Board it was quite in order.

Mr. Muttukumaru continued that in his opinion out of the discussion that ensued, there was only one point for the consideration of the Board and that was for adequate supervision of those societies, which he agreed was definitely necessary. He felt that advise and official backing was necessary for the effective functioning of these C. A. P. & S. Societies, but the societies should at the same time realize that these were run by the people themselves and should not expect too much from Government and they should stand on their own feet. In certain areas they had not come up to that stage and Government should give the necessary guidance. In reference to a statement by the Director, Land Department, that Rural Development Societies also contributed to the production of food, he said he was a strong believer of the Rural Development Scheme sponsored by Government and he would certainly put forward the suggestion that these Rural Development Societies be one of the agencies of promoting the Agricultural Production and Sales' Societies, and that statutory provision be made to represent Rural Development Societies in District Agricultural Committees and Agricultural Production and Sales' Societies. He also added that a representative from the Rural Development Societies should be a member of the District Agricultural Committee in view of the interests they

had in the production of food in this Island. He emphasised that Rural Development Societies had contributed appreciably to the improvement of the country and towards the improvement of food production to some extent.

Gate Mudaliyar Wickremaratne said that it was a great encouragement for him to see that at least two members of the Board have been in constant touch with the working of the C. A. P. & S. Societies. He thanked the Registrar of Co-operative Societies for the assurance he gave that C. A. P. & S. Societies would take more interest in the production of food and said that if he had seen the memorandum on the subject earlier he would have made certain references in the course of his remarks. He added that he had no objection to supporting that motion of appreciation, but before he did so, he would like to know how many societies have been assisted in the way of a grant of materials such as mammoties.

The Registrar of Co-operative Societies replied that in every area there are Inspectors appointed who go closely into the working of the society and then make a recommendation in relation to the work done by that society. His department was responsible for the return of those loans and he was glad that whatever loans had been granted on the recommendations of his officers have been promptly repaid.

Honourable Mr. Amarasuriya suggested to the Chair that this subject had been discussed sufficiently and that it be considered closed.

The Chairman agreed that this subject had taken a good deal of time and wished to put the motion before the House.

Honourable Mr. Amarasuriya suggested that the motion be slightly amended to read thus—" That the Board whilst expressing its appreciation of the work done by Government Departments with respect to Agricultural Production and Sales Societies, requests that there should be a further expansion of the activities of the societies."

The motion was put to the House and carried.

The next item 1 (*b*) was also a discussion by Gate Mudaliyar Wickremaratne on the following:—" Consider ways and means of making use of existing cattle in the villages to produce milk and milk products through Co-operative Dairy Societies. "

Gate Mudaliyar Wickremaratne said he would like to bring it up at a subsequent meeting and that Sir Wilfred de Soysa's memorandum which he promised to submit would also help the discussion.

Mr. Spencer Schrader wished if it could be discussed without a postponement since it was very rarely he agreed with Gate Mudaliyar Wickremaratne and that that was one instance.

Gate Mudaliyar Wickremaratne replied that he was glad Mr. Schrader was able to agree with him and consented to take up the discussion. He said that in certain parts of this Island where there were a large number of cattle, particularly in the North-Central Province, the milk produced was not being properly utilized. He said he was glad to learn that since of late there is a system of distribution of milk in the North-Central Province. According to the Census of 1946 there were 76,000 neat cattle and 58,000 buffaloes in the North-Central Province. The population of the district was 105,000. There were at least 10,000 children under two years of age. He suggested that if even 20,000 cows in milk were selected who could give at least half a bottle of milk a day, the requirements of those children would be met and that it would serve a very useful purpose. He was at a loss to understand why this was not possible when there was ample land for grazing of cattle If some action in this direction could be taken it would not only improve the village cattle but the villager would also be benefited. This, he felt, could be done if a few Co-operative Societies were started in the village and the villagers were taught to milk the cows, so that even if ¼ bottle of milk was obtained from each cow, the quantity would gradually increase with regular milking. He had learnt that C. A. P. & S. Societies had distributed barbed wire to cultivators and that would help them to look after their cattle and make use of the dung as farmyard manure for their cultivation purposes.

Major E. C. de Fonseka said that he had moved a resolution in the last meeting urging the appointment of a Milk Commissioner and a Milk Board and that if it were implemented it would help in this direction.

Mr. B. F. Perera. Commissioner of Rural Development, said that his Department had already started a Co-operative Milk Supply Scheme. They were supplying milk feeding centres with cows milk without using imported milk and they hoped to extend that scheme with the help of C. A. P. & S. Societies by way of loans for initial expenditure of the people to put up sheds, cement the floors, and construct enclosures for cattle. Already work in that direction has started in the North-Central Province.

Mr. R. H. Spencer Schrader believed that much could be done to improve the village cattle instead of importing cattle that did not suit our conditions and climate. He had seen the cattle at Karagoda-Uyangoda and they were yielding an appreciable quantity of milk compared to what it used to be. He said that what was required in the case of village cattle was regular milking so that the yields might improve. He was aware of the fact that most of the villagers did not use the milk nor the farmyard manure that the cattle could produce. He emphasised that he was of opinion that Co-operative Societies could effect enormous improvement in that respect. He added, " We in Ceylon could be proud of everything except our cattle. When it comes to a question of improving our cattle then we have to import animals from temperate countries that cannot thrive in this country. They cannot thrive as apples in Puttalam or Jaffna. We are trying to bring animals that are not suitable for our climate. Either we must make our conditions suit the animals or get animals to suit our conditions. "

Mr. A. M. Clement Dias said that he had read a booklet which says that 15 bottles of milk were produced in the first crossing, whereas some of the members who spoke earlier said that they had improved the local cattle. It has taken 13 years since the scheme for the improvement of local cattle was started but yet the average local cattle were not able to produce a bottle of milk a day. Some years ago an expert had come here from England who was of opinion that cross breeding was bad. He made his report and left the Island and nobody knows whether his suggestions were accepted and tried out. In Australia the population is 7 million and the cattle population was also 7 million which worked up to about 2 to 3 gallons of milk per animal, whereas in Ceylon the population is 7 million and the cattle population is only about 1½ million. He added that during the last two wars the people of Ceylon were able to get their food because her raw material was supplied cheap and he believed that milk production in the Island would add to the food supply if milk production was improved. In certain areas ample milk was produced and there was no possibility of selling it. He had in one of his own estates a herd of cattle which produced about 40 bottles of milk a day. He had found it impossible to sell the milk and ultimately he had to dispose of his cattle. He added that he was aware of the fact that cattle could easily be brought up in coconut estates. In conclusion he said that he would submit a memorandum on the subject before the next meeting of the Board and also show a film of 1,500 ft. to the members.

Sir Wilfred de Soysa said that it would take a number of years before Ceylon could be self sufficient in milk. He felt that it would take several generations for the indigenous Sinhala breed to produce the quantity of milk the country requires. Giving a long account of the various dairying institutes he had visited during his tour of Ireland, he emphasised that to bring Ceylon to that stage Ceylon should first think of improving her pasture and should establish communal pasture grounds. In conclusion he said that this was not a subject that should be discussed by a few members of the Board, but a Commission should be appointed to go into the matter.

Senator Justin Kotelawala said that one thing that strikes him most regarding Mudaliyar Wickremaratne's discussion was a scheme of insurance of cattle. He has been trying to promote the idea of cattle insurance among the people of this Island but they seemed to be quite averse to the idea of cattle insurance owing to the various problems involved in it. Therefore he thought that it was time the Government took some measures to appoint some expert to go into this matter. He wondered why cattle should not be insured if cars, buses, &c., could be insured. He also felt that if Government could

encourage artificial insemination with semen imported from other parts of the world, the money spent would be worth the while. He said that this method was much better than importing cattle from other countries which are not acclimatized to the conditions in this country. He added that Ceylon had the cows and it had the grass, Molasses, the " million dollar grass " and therefore much could be achieved by way of artificial insemination. Incidentally he remarked that " Molasses " had been very highly recommended to him by the Minister and was supposed to be the " million dollar grass. " He had been anxious to try it on his estates and had written to the department for a sample of the seed but had not heard from the department since then. He said that this might be an excellent idea for estate owners to try this out in little patches on their estates.

Honourable Mr. Amarasuriya said that Senator Kotelawala had made two suggestions during the course of discussion of the subject at issue. One was to encourage Soya bean into the diet of the people and the other was an insurance scheme for cattle. In view of the discussions there was general information that the existing milk in the Island should be utilized and that the production of milk should be increased. He would therefore rise only to move a motion arising from that discussion.

Honourable Mr. Amarasuriya moved the following resolution:—

" THIS BOARD RECOMMENDS UTILIZING THE EXISTING CATTLE IN THE VILLAGES TO PRODUCE MORE MILK AND MILK PRODUCTS THROUGH CO-OPERATIVE DAIRY SOCIETIES AND TAKING ALL NECESSARY STEPS TO INCREASE PRODUCTION OF MILK. "

A. E. Madawala Dissawa seconded the resolution.

The motion was put to the House and carried.

Mr. T. M. Z. Mahamooth, Deputy Director (Animal Husbandry) said that the distribution of milk was tried by the Veterinary Department a few years ago in a rather backward area a little away from Polonnaruwa called Mampitiya. The scheme was to collect milk from village areas at a central spot at the rate of 10 cents a bottle. The milk thus collected was converted into ghee and sent out to other parts of the country at a fair profit. This showed that the country had a fair amount of milk which could be utilized but the difficulty was the lack of proper organizations to utilize the milk that was available and to transport it to places where it could be utilized more profitably. He felt that the motion that was brought forward at the last meeting of the Board by Major Fonseka about the appointment of a Milk Commissioner and the organization of a Milk Board would help in this direction. He agreed with the views expressed that some sort of organization was necessary to distribute the milk that was available to all parts of the Island and to make the best of the supplies already available. In the North-Central Province Co-operative Dairies have already started on the lines envisaged by Gate Mudaliyar Wickremaratne. These societies were able to collect the available milk in a central spot and are utilizing it for the purpose of supplying Milk Feeding Centres. He said that our Propaganda Department was taking an active interest to help the Co-operative Societies in the proper utilization of surplus milk.

With regard to the point raised by Senator Kotelawala in connection with artificial insemination he said that the members would be aware that the Veterinary Department has experimented successfully with this method with semen produced at the Peradeniya Laboratory. These experiments have been carried out in all parts of Ceylon including Colombo and the far north. The semen was transported to those areas either by train or by motor cars and the insemination was carried out by officers in the field. The difficulty he had experienced was with regard to the proper storing of the semen and refrigeration facilities. With modern transport conveniences by air, semen could easily be obtained either from Australia, India, or even England, in a matter of a few hours and with the methods of preservation available at the moment, it would be done without difficulty but the actual difficulty would be to have the cows owned by private individuals in readiness for insemination because they could not be fertilized at any time of the month or year as they come into heat once in 21 days.

At this stage Senator Kotelawala inquired for how many days the fluid could be preserved.

Mr. Mahamooth, D.D. (A.H.) replied that the semen could be preserved for 6 days under refrigeration.

He continued that the difficulty would be to have the cows in heat when the semen is available and if long distances had to be travelled in the Island it was necessary to have a large number of officers to do that work. The programme in view was to increase the number of artificial insemination centres when refrigeration plants under order are got down. He explained that it was difficult to obtain refrigeration plants these days and added that these would be installed at several centres like Jaffna, Bandarawela, Badulla, Colombo, Galle. Whenever there were calls from cattle owners, officers from these centres would be sent out for carrying out the work. In regard to the question raised about getting down semen from abroad, he said that semen could be brought from India and England but in the first instance he felt it was better to carry it out as a trial.

Referring to the question about cattle insurance, he believed that firms were reluctant about the acceptance of a cattle insurance scheme owing to the incidence of disease in the Island. In England and other temperate countries the position was quite different because Tick fever and other dangerous diseases were not very common. Tick fever was a serious problem in Ceylon especially with cattle imported to this Island from temperate countries. Contagious abortion and other diseases like Anthrax and Rinderpest were diseases that occurred in this country and that was why insurance firms were rather reluctant to take the risk. But he could not understand why it should be so, because animals could easily be protected against Anthrax and Rinderpest. A few years ago Mr. Mahamooth had personally carried out insemination with semen from an imported Sahiwal bull. A variety of animals were inseminated very successfully including two Sinhala cows. He said that when semen from a bull of a bigger breed was used, it was the mother that controlled the size of the offspring. He also added that if a better breed of cattle were to exist under village conditions, the villager should spend more time looking after the cattle than he normally does in the case of the village cow. He should also spend some time in growing improved grass because the village cattle have adapted themselves to the conditions prevailing, whereas the imported cattle would not thrive under the same conditions.

Item 2 on the Agenda was taken up next, namely, Mr. A. Hensman to move that:—

"THE CENTRAL BOARD OF AGRICULTURE RECOMMENDS THAT EARLY STEPS BE TAKEN BY THE HON'BLE THE MINISTER OF AGRICULTURE AND LANDS TO INTRODUCE LEGISLATION FOR THE EFFICIENT MANAGEMENT, INCLUDING SOIL CONSERVATION MEASURES OF TEA, RUBBER, COCONUT AND OTHER ESTATES OF ABOUT 100 ACRES AND OVER IN EXTENT, PURCHASED BY CEYLONESE AND OTHERS IN RECENT TIMES FROM EUROPEAN OR OTHER CONCERNS."

In moving the above resolution Mr. Hensman said that recently at a meeting of the Ceylon Estate Staffs Association, the Chairman had referred to the appalling conditions to which a number of estates had fallen as a result of mismanagement and discontinuance of Superintendents and labourers who have been employed on estates for a number of years. He emphasised that false economy practised by new proprietors who had very little knowledge of efficient management of estates resulted in discontinuance of labour and thereby creating Communists. Estates were fast running into weed. Manuring, &c., have been drastically reduced or stopped altogether and these new proprietors looked on them as mere material for making quick money. He added that this was a matter of national interest since estates constituted an important source of the income of this country. He believed that the best method of protecting these estates from deterioration was to introduce legislation for the appointment of Visiting Agents who should see that a programme of work considered necessary for the estate was carried out. The State should be in a position to give employees on these estates some sort of assurance in the security of their service, and should not be allowed to be thrown out of employment at the whims and fancies of the employer. In conclusion he said that new proprietors were still benefitting from the work of years put in by Superintendents but ruthless cutting down of expenditure and underpaid Superintendents were undoing the good work of years.

Major E. C. de Fonseka said that while agreeing in principle with that resolution he was unable to support it since it made a distinction between estates recently acquired and others. Unfortunately he had himself purchased an estate recently and he could say that all estates are not in a very good condition when they are sold, and in fact in many cases new proprietors were doing a better job than was ever done before.

Senator Justin Kotelawala said that he felt Mr. Hensman was rather prejudiced against his own countrymen. Soil erosion of this country had been started by non-Ceylonese not knowing the tropical conditions. It was due to the wanton knowledge of the Europeans that came to this country to do agriculture in the wrong way. Therefore the mover's conception that non-Ceylonese estates have been well managed is a myth that was exploded many years ago. It is a well known fact that Gampola District was ruined by European planters who clean weeded the ground without realizing the damage erosion could do. Those planters who only knew the conditions in England did not know how heavy the rainfall here was. Therefore he said that the mover's own argument that Ceylonese who buy estates do not weed the land is not a sound argument and he did not think that any decent respectable Government would accept a resolution like that. He also emphasised that looking after the soil and its conservation was the most important item in agriculture but as for the neglecting of estates by bus magnates and " mudalalis " who have bought estates newly, they would not repeat the mistake once they realise that their crops were diminishing and the profits as a result were going down. In conclusion he said " It is not in keeping with our dignity to pass a resolution of this nature. "

Mr. Thomas Amarasuriya said that with whatever good intentions Mr. Hensman had introduced that resolution he would say that the mover drew a distinction between Ceylonese and non-Ceylonese which was a serious reflection on the nationals of this country, particularly when there was a talk of Ceylonization on estates. He said that the nationals of this country were trying to establish the fact that estates managed by Ceylonese were in no way inferior to those managed by non-Ceylonese and it looked as if the mover was suffering from an inferiority complex. He said that it may be true that a few of the Ceylonese estates that have been purchased during the last few months might not be working well as others but this was not so in all cases. There was a time when it was thought that only European Civil Servants could manage Departments. Now there are Ceylonese Civil Servants who have proved even superior to the Europeans. He felt that the mover should either withdraw that resolution or alter the wording of that resolution.

Mr. Hensman said that it was not his intention to draw a distinction between Ceylonese and non-Ceylonese when he introduced that motion. This was evident from the wording of the resolution which says " Ceylonese and others. " He however withdrew the resolution and said that it would be brought up at a subsequent meeting in an amended form.

Next item on the agenda was a motion by Mr. R. T. Chelliah:—

" THAT THIS BOARD IS OF OPINION THAT TO ENCOURAGE PADDY CULTIVATION IN CEYLON THE RAILWAY TRAVELLING CONCESSION FOR AGRICULTURAL LABOURERS SHOULD BE REINTRODUCED UNTIL CEYLON FOOD SITUATION COMES TO NORMAL. "

Before the motion was introduced, the Chairman said that the General Manager of Railways has informed that this concession to agricultural labourers was withdrawn on the instructions of the Ministry of Transport owing to the increased cost of running the Railway. This concession had been withdrawn in October, 1949, and he felt that if it had to be reintroduced and the Board was introducing a motion on the subject, the prior approval of the Minister was necessary. He however gave an undertaking that the matter would be taken up with the Ministry and the Board would be informed of the reply.

Item 3 (*b*) was next taken up. Mr. R. T. Chelliah to move:—

" THAT THIS BOARD IS OF OPINION THAT FOR THE PROTECTION OF CATTLE FROM DANGEROUS DISEASES, VETERINARY HOSPITALS WITH FULL MEDICAL EQUIPMENT AND STAFFS BE ESTABLISHED IN ALL AGRICULTURAL DISTRICTS IN CEYLON. "

In introducing the above motion Mr. Chelliah spoke at length of the dangers and difficulties that village cultivators are confronted with owing to lack of veterinary medical facilities for their cattle. He was aware of instances when animals owned by villagers were prescribed drugs by the local A. V. S., and most of these drugs were not available except in a central town. In most places they had to reach a town on foot. Owing to these difficulties the villagers very seldom go to the local A. V. S. for advice and to avoid these hardships they go to the nearest "Vedarala." Therefore he felt that veterinary hospitals in agricultural villages was an urgent need in this country if the village cultivators were really to benefit from the Veterinary Service run by the Agricultural Department. He would also like to suggest that the Government should stop A. V. SS. doing private practice and to compensate for it a better salary should be paid. He said he made this suggestion in order that A. V. SS. would serve the rich and the poor alike. He suggested that every D. R. O's Division should have a Veterinary Dispensary and that medicine should be issued to the villagers free of charge.

Senator Justin Kotelawala said he had great pleasure in seconding that resolution because it would produce far-reaching results. He believed that money spent on a matter of that nature would be money well spent. He said that if the resolution was implemented it would not only mean improving the conditions of cattle in villages but the general health of the people would improve. The villagers would be at an advantage to get their poultry vaccinated in addition to facilities given to cattle and even artificial insemination could take place in those hospitals envisaged in the resolution. He hoped that the resolution would receive full support of the House.

Mr. U. B. Unamboowe in supporting this resolution said that he was aware of a villager who owned a really good cow which suddenly fell ill. He was unable to get any assistance from anywhere and ultimately the animal died. He therefore felt that veterinary hospitals suggested by the mover would be very helpful in villages.

Honourable Mr. Amarasuriya speaking next, said that the object of that resolution was very laudable, but he felt that members should take a more practical view of the situation. He said that the country could not afford to put up veterinary hospitals in villages before the needs of human beings in this country were satisfied. Therefore he requested the mover to amend the motion to read that one hospital be established first as an experiment. He added that the principle must be accepted but he could not think whether they could expect such institutes to come up overnight. He finally suggested that as there was already one veterinary hospital at Peradeniya another one be established elsewhere.

Sir Wilfred de Soysa said that at the annual meeting of the Veterinary Association it was put forward very forcibly by the members that the Veterinary Branch was very much understaffed. It was the opinion of most of the members that there should be at least 400 to 450 Veterinary Surgeons throughout the Island to carry out the work satisfactorily.

Mudaliyar Abulcassim Maraikar said that while he agreed with the motion introduced by Mr. R. T. Chelliah and with the views expressed on the motion, he also felt that a more practical view of it should be taken as suggested by the Honourable the Minister of Trade and Commerce. He suggested as a *via media* that A. V. SS. who are posted to different districts should be fully equipped and should be given First Aid Boxes of veterinary medicines so that whenever an animal was ill, it would be possible to some extent, to save the animal. In conclusion he requested Mr. Mahamooth to take necessary action in this matter if the House agreed with the motion.

Mr. T. M. Z. Mahamooth, Deputy Director (Animal Husbandry) in making his observations on the resolution said that Mr. Chelliah had grouped all the dangerous diseases into one and therefore a word of explanation would be necessary. When he refers to dangerous diseases he believed that the reference must be to dangerous communicable diseases. These diseases come under the Contageous Diseases Ordinance and the Veterinary Department was responsible for the control and eradication of the diseases and whatever measures are necessary to control the disease from spreading. He was of opinion that where such diseases were concerned, veterinary hospitals or dispensaries would serve little purpose. In the case of a disease like Rinderpest or Anthrax, action had to be taken according to

circumstances that would crop up. A dispensary or a hospital situated at a particular spot would serve very little purpose as it would not be possible to shift the hospital or the dispensary to the place where the disease has occurred. Normally in the case of an outbreak the animals were kept in segregation. At the last outbreak in 1946 there were outbreaks in some 10 or 15 stations and action had to be taken to bring the disease under control in all these stations. There was an outbreak of Anthrax at Kandavalai and in spite of the difficult conditions prevailing there they managed to control the outbreak within a month and were able to eradicate the disease. He explained that Anthrax was very dangerous because even after the disease is brought under control infection could spread through the soil in which organisms could live. The effects of sun and rain could not destroy these organisms and as a result it becomes dangerous to susceptible animals from time to time. They had carried out vaccination of all susceptible animals and that was the only method by which the spread of the disease could be controlled. With regard to other diseases like poultry plague they have been able to carry out vaccination of poultry practically in all parts of the Island. The Veterinary Research Laboratory at Peradeniya was preparing the vaccine necessary to meet these exigencies. They were able to send vaccinators all over the Island and with the help of Veterinary Surgeons stationed in districts and Veterinary Conductors they were able to meet the situation absolutely satisfactorily. Some 7 or 10 years ago a veterinary dispensary was started in Jaffna Town but the response was very poor and the dispensary had to be closed down. Another dispensary was started at Ratnapura and this too had to be closed owing to lack of response from the public. However, the dispensary and hospital at Peradeniya are working very satisfactorily although at the inception there was difficulty in persuading people to bring their sick animals to the hospital. Some were in the habit of bringing their animals only when they were very ill or about to die. But now the position at Peradeniya Hospital has improved and all types of animals mostly dogs, cattle, poultry, horses and even elephants occasionally, are brought in for treatment. There was a possibility of hospitals being established at each of the following places:—Jaffna, Galle, Bandarawela. He also added that he hoped to see the hospital at Jaffna functioning in the very near future. Wherever Assistant Veterinary Surgeons were posted, it was hoped to have a small dispensary attached to each of them so that animals could be brought to him and treated free of charge. As some members had remarked the difficulty was shortage of staff. Members would be aware of the fact that a veterinary man after three or four years of training had to start on a 100 rupees with the result that parents did not want to send their children and spend on them for a veterinary course as the salaries were not attractive. But since 1946, the prospects of a Veterinary Surgeon were definitely better and members would be glad to know that there were 25 or 30 young men undergoing training in places like Australia, India and Great Britain and the prospects of increasing the cadre were very bright. At the moment it has become necessary to employ a few foreigners due to lack of trained personnel in the Island and he hoped that this difficulty would not be experienced in a few years. He said that most of the areas envisaged by the mover would be served when the staff was adequate and as for the dangerous diseases he had in view, veterinary hospitals would not serve a useful purpose because as already mentioned, in the case of an outbreak the transport of animals to the hospital is not done and they have to be segregated in segregation camps. In certain cases it becomes necessary to destroy the animals.

Mr. Justin Kotelawala said that the Minister's proposal to amend the motion as human beings had to be looked after first seemed as if he was putting the cart before the horse. If their animals and poultry were looked after it would mean production of more food and thus helping the people. In regard to Mr. Mahamooth's remark that hospitals are not of much help during the time of an epidemic, he would like to say that the mover's point of view was to create greater stimulus among villagers to look after their animals if such institutions were started.

The Chairman in consideration of the different views expressed on the motion amended it to read as follows:—

"THAT THIS BOARD IS OF OPINION THAT A FEW MORE VETERINARY HOSPITALS BE ESTABLISHED IN DIFFERENT DISTRICTS OF THE ISLAND WITH AS LITTLE DELAY AS POSSIBLE."

The Chairman formally moved the following resolution in view of the services rendered by Mr. Rhind, the former Chairman, to the Board and the country in general, as Director of Agriculture:—

"THIS BOARD WISHES TO PLACE ON RECORD THE INVALUABLE SERVICES RENDERED BY MR. D. RHIND, LAST DIRECTOR OF AGRICULTURE, TO AGRICULTURAL PROGRESS DURING HIS TENURE OF OFFICE IN THE ISLAND."

The Board accepted the motion with acclamation and the meeting terminated at 5.30 p.m.

R. L. ARNOLDA,
Secretary,
Central Board of Agriculture

Peradeniya, December 14, 1950.

MINUTES OF THE MEETING OF THE BOARD OF THE TEA RESEARCH INSTITUTE OF CEYLON HELD AT 2.30 P.M. ON WEDNESDAY, DECEMBER 20, 1950, AT THE OFFICE OF THE PLANTERS' ASSOCIATION OF CEYLON, 113, STEUART PLACE, COLOMBO

Present.—Mr. R. C. Scott, C.B.E. (Chairman) ; The Chairman, Planters' Association of Ceylon (Mr. R. C. L. Notley) ; The Chairman, Agency Section, Planters' Association of Ceylon (Mr. G. K. Newton) ; The Acting Director of Agriculture (Dr. A. W. R. Joachim) ; The Acting Secretary to the Treasury (Mr. A. G. Ranasinha, C.M.G., C.B.E., C.C.S. ; Messrs. R. Singleton Salmon, C.B.E., H. de T. Wilkinson Kay, J. C. Kelly, W. H. Attfield, H. S. Hurst, and Mr. J. Lamb (Director and Secretary).

Messrs. W. Neal de Alwis, J.P., U.M., Leo B. de Mel, J.P., U.M., Errol Jayawickreme and the Acting Superintendent, St. Coombs Estate (Mr. Bruce Gibbon) were present by invitation.

Notice convening the meeting was read.

1. MEMBERSHIP OF THE BOARD AND COMMITTEES

(*a*) *Board :*

The Chairman reported that—

(i) Mr. F. A Bond had resigned his seat as from November 15, 1950, and Mr. W. H. Attfield had been nominated by the Agency Section of the Planters' Association to fill the vacancy.

(ii) Mr. A. G. Ranasinha, C.M.G., C.B.E., C.C.S., had been appointed to act for Mr. T. D. Perera, C.M.G., C.C.S., Secretary to the Treasury, during the latter's period of absence from the Island on leave.

The Chairman on behalf of the Board thanked Mr. Bond for the valuable service he had rendered to the Institute as a member of the Board and extended a cordial welcome to Messrs. Attfield and Ranasinha.

(*b*) *Estate and Experimental Sub-Committee*—

The Chairman reported that Mr. S. Vytilingam had accepted the Board's invitation to serve on the above Sub-Committee.

2. MINUTES OF THE MEETING OF THE ESTATE AND EXPERIMENTAL SUB-COMMITTEE HELD ON SATURDAY, DECEMBER 9, 1950

The Chairman said that as will be seen from the copies of the minutes which were before them, the main item considered at the above meeting was the St. Coombs Estate Estimate for 1951.

3. FINANCE

(i) *St. Coombs Estate Extra Votes for 1950.*—The Chairman invited the attention of members to the list of extra votes amounting to Rs. 20,355·78 in all asked for by the Acting Superintendent, St. Coombs, and copies of which have been tabled. These were very fully considered by the Estate and Experimental Sub-Committee on December 9 and the over-expenditure in most items was due to the increase in dearness allowance and wages.

Mr. G. K. Newton said that the members of the Estate and Experimental Sub-Committee were all satisfied that this was unavoidable and proposed that the votes asked for should be sanctioned. Mr. J. C. Kelly seconded the proposal which was passed.

(ii) *Estimates for 1951.*—The Chairman said that the estimates for 1951 had been very carefully scrutinised in the morning by the Finance Sub-Committee. He proposed to go through the estimates seriatim and invited any member of the Board to ask questions relevant to each item as it came up for consideration.

(*a*) *Estate Estimates : Revenue Account.*—The Chairman said that the total estimated expenditure for 1951 was Rs. 407,543·82 with the cost of production at Rs. 1·85 per lb. as against Rs. 349,828·38 and a cost of production of Rs. 1·59 in 1950. The crop for 1951 was estimated at 220,000 lb. which at an average selling price of Rs. 2·24 would bring the receipts from sales to Rs. 492,800. The estimated profit from St. Coombs for 1951 would therefore amount to Rs. 85,250. He referred to the note on the last page of the estimates where comparative figures were given to show that increases in wages and dearness allowance paid to staff and labourers accounted for the increase in cost of production.

(*b*) *Research Estimates : Capital Account.*—The Chairman said that estimated expenditure on capital account on the research side amounted to Rs. 172,900. It was pointed out that Rs. 65,700 out of the total of Rs. 95,450 were revotes from 1950 for the extension to the laboratory building (administration block), the Roland Norris Memorial Hall and water sanitation for the St. Coombs Cadday. Provision was also made for reconditioning one set of sub-staff quarters and for building another. Provision for capital expenditure on the Low-Country Sub-Station was also necessary.

Research Revenue Account.—The Chairman pointed out that the increase in the total of the estimated expenditure on Research Revenue Account for 1951 over that for 1950 was attributable to increases in salaries and dearness allowances.

There being no amendments to the Research Estimates the complete estimates for the year 1951 were approved on the proposal of Mr. J. C. Kelly seconded by Mr. H. de T. Wilkinson Kay.

4. ANY OTHER BUSINESS

(*a*) *Analytical Control.*—The Director raised the matter of analytical control which the Institute was being asked to undertake in view of the possibility of estates undertaking large scale spraying as a protective measure against blister blight. He had been in communication with the Planters' Association and has also discussed the matter with the staff. He said that if the scheme was to be set up additional staff comprising 1 graduate, 1 officer on junior staff grade and 1 peon would be required as it would be impossible for the present staff to carry out the work. This would in turn necessitate the building of additional quarters to accommodate the staff. He estimated the revenue expenditure to be about Rs. 30,000 and capital expenditure about Rs. 57,205 making a total of Rs. 87,205. On a basis of 500 samples per week in duplicate, *i.e.*, approximately 50,000 actual determinations per annum it would be necessary to levy a

charge of Rs. 1·50 per sample to offset the revenue expenditure incurred. Requests for such analyses were being received from estates and if the Institute were to undertake such work with the present staff it would mean the closing down of all routine work now in hand.

Mr. R. C. L. Notley said that it was very essential that no teas should be exported from Ceylon having a copper content in excess of the tolerance figure allowed. He thought the T.R.I. should get the scheme going, engage staff, put up buildings to house them and charge fees for the work undertaken.

Mr. H. de T. Wilkinson Kay thought that the estimate of 100,000 samples per annum rather an optimistic figure and that the Institute should be protected in the matter of finance.

The Director said that the Institute could not afford to set the scheme going as funds were not available and thought it would be difficult to undertake the work unless the Institute was provided with the necessary finance.

In the discussion that followed all members were convinced that the carrying out of such analyses of tea samples was a definite necessity and that ways and means of obtaining the required funds should be explored.

Finally the Board agreed to the Chairman's suggestion that the Institute should not undertake to carry out such analyses until a separate department was set up and further that the Institute should not be committed to any extra expenditure or work which would impede the normal routine of research work now in progress.

(*b*) *9th Biennial Conference.*—The Chairman paid tribute to the Director and his staff for the excellent Conference which was held in Nuwara Eliya on December 1 and 2 and repeated on December 4 and 5. Everyone he had met and spoken to regarding this conference had nothing but praise for the very excellent arrangements and the high standard of the papers read out. He moved that the Board record its appreciation. Passed with acclamation.

The meeting terminated with the Chairman wishing the members a Happy Christmas and a Bright and Prosperous New Year.

(Sgd.) J. LAMB,
Secretary.

Tea Research Institute,
Talawakelle, February 19, 1951.

Rubber Research Scheme (Ceylon)

MINUTES OF THE 103RD MEETING OF THE RUBBER RESEARCH BOARD HELD AT THE PLANTERS' ASSOCIATION HEADQUARTERS, COLOMBO, AT 2.30 P.M. ON MONDAY, NOVEMBER 6, 1950

Present.—Mr. F. H. Griffith (in the Chair) ; Mr. Francis Amarasuriya ; Mr. L. S. Boys ; Dr. A. W. R. Joachim (Director of Agriculture) ; Major M. Jayawickreme, M.P., Mr. J. L. D. Peiris and Dr. E. Phillis (Director, R. R. S.).

Letters from Mr. A. G. Ranasinha, C.M.G., C.B.E., and Senator C. Wijesinghe regretting their inability to attend were read.

1. MINUTES

Draft minutes of the meeting held on September 28, 1950, which had been circulated to members, were signed by the Chairman.

2. REPORTS AND ACCOUNTS

(*a*) *Report on Oidium investigations*—Advisory Circular No. 28, advance copies of which had been circulated to members, was tabled. The Board decided to record its appreciation of the excellent work done by Dr. Young.

(*b*) *Statement of Receipts and Payments for the 3rd quarter, 1950*, was approved.

(*c*) *Estate Accounts for July and August, 1950*, were tabled.

(*d*) *Estimates of Income and Expenditure for 1951*—Draft estimates for 1951 covering income and expenditure as follows were approved :—

		Rs.	*Rs.*
Estimated income		..	1,442,300
Estimated expenditure—Recurrent		910,720	
Capital		297,000	1,207,720
Estimated excess of income over expenditure ..		..	234,580

3. STAFF

Research Assistants.—A motion to provide scholarships for training abroad a few graduates with the object of absorbing them into the Scheme's service at a later date was considered, and the Director was asked to make enquiries regarding the availability of suitable men.

Three appointments were made to the grade of Research Assistant.

4. LONDON ADVISORY COMMITTEE

Agreed that the annual contribution to the Committee be increased to £2,300.

5. TRAINING IN ESTATE WORK

A proposal to run a refresher course for Estate Superintendents was considered and general approval given to the principle.

Dartonfield,
Agalawatta, November 14, 1950.

(Sgd.) C. D. DE FONSEKA,
Secretary-Accountant.

Rubber Research Scheme (Ceylon)

MINUTES OF THE 104TH MEETING OF THE RUBBER RESEARCH BOARD HELD AT THE PLANTERS' ASSOCIATION HEADQUARTERS, COLOMBO, AT 2.30 P.M. ON MONDAY, DECEMBER 18, 1950

Present.—Mr. F. H. Griffith, M.P. (in the Chair); Mr. Francis Amarasuriya; Mr. L. S. Boys; Major M. Javawickreme, M.P.; Mr. F. A. Obeysekera; Mr. J. L. D. Peiris; Mr. W. J. A. Van Langenberg (representing the Minister of Finance); Senator C. Wijesinghe and Dr. E. Phillis (Director).

1. MINUTES

Draft minutes of the meeting held on November 6, 1950, which had been circulated to members, were confirmed and signed by the Chairman.

2. MATTERS ARISING FROM THE MINUTES

Research Assistants.—Reported that Messrs. P. W. W. de Silva, A. J. Jeevaratnam and S. Natesan had accepted appointment as Research Assistants and were expected to assume duties in January, 1951.

3. REPORTS AND ACCOUNTS

(*a*) *Auditor-General's Report and Balance Sheet for 1949* were approved.

(*b*) *Revote of 1949 capital votes.*—Balances of 1949 capital votes amounting to Rs. 35,711 were re-voted for 1950.

(*c*) *Investments.*—The investment of Rs. 148,150 in Ceylon State Mortgage Bank Debentures was reported and approved.

(*d*) *Loans to Co-operative Societies.*—Approval was given for financial assistance being provided for the formation 4 co-operative centres for rubber production by smallholders.

4. STAFF

(*a*) *Secretary-Accountant.*—Mr. C. D. de Fonseka was offered re-engagement for a further period of 4 years on the termination of his present contract.

(*b*) *Junior Staff.*—Changes in junior staff were reported.

(*c*) *Dearness Allowance* The increase in D. A. to junior staff, following on changes introduced by Government, was approved.

5. PUBLICATIONS

The following publications were tabled :—

(*a*) Special Quarterly Circular.

(*b*) Advisory Circular No. 28.

6. INTERNATIONAL CONFERENCE ON LATEX

Agreed that the Director should attend this conference which is to be held in Malaya February 1951.

(Sgd.) C. D. DE FONSEKA,
Secretary-Accountant.

Dartonfield, Agalawatta.

Rubber Research Scheme (Ceylon)

MINUTES OF THE 105TH MEETING OF THE RUBBER RESEARCH BOARD HELD AT THE PLANTERS' ASSOCIATION HEADQUARTERS, COLOMBO, AT 2.30 P.M. ON WEDNESDAY, FEBRUARY 7, 1951

Present.—Mr. F. H. Griffith, M.P., in the Chair ; Mr. Francis Amarasuriya ; Mr. L. S. Boys Major Montague Jayawickreme, M.P. ; Dr. A. W. R. Joachim ; Mr. F. A. Obeyesekera ; Mr. J. L. D. Peiris ; Senator C. Wijesinghe ; Dr. E. Phillis (Director).

An apology for absence was received from Mr. W. J. A. van Langenberg, Controller of Finance & Supply.

1. MINUTES

Draft minutes of the meeting held on December 18, 1950, which had been circulated to members, were confirmed and signed by the Chairman.

2. DIRECTOR'S RESIGNATION

A letter from Dr. E. Phillis tendering his resignation from the post of Director was considered. The resignation was accepted and it was agreed that Dr. H. E. Young, Oidium Research Officer, should act as Director for a period of six months.

Dr. Young came into the meeting at this stage.

3. ANY OTHER BUSINESS

Specified and blended bale rubber.—It was noted that samples had been collected and sent to London for examination. The Scheme's newly appointed Chemist would work on them ; he would also bring out the equipment ordered in this connection.

Dartonfield,
Agalawatta, February 27, 1951.

C. D. DE FONSEKA,
Secretary-Accountant.

SUMMARY OF OUTBREAKS OF SCHEDULED ANIMAL DISEASES WITHIN THE DOMINION OF CEYLON—MONTH ENDING OCTOBER 31, 1950

Province	Disease	Fresh Cases during the month	Total number from the beginning of this calendar year to October 31, 1950				Balance ill at end of month
			Diseased	Deaths	Shot	Recoveries	
Western Province	Foot-and-mouth	—	67	—	—	67	—
	Rabies	—	1	1	—	—	—
Colombo Municipality	Foot-and-mouth	—	430	—	—	430	—
	Anthrax	—	4	4	—	—	—
	Tuberculosis	—	2	2	—	—	—
	Piroplasmosis	—	6	6	—	—	—
	Mange	—	24	—	—	24	—
	Rabies	10	77	77	—	—	—
Quarantine Station	Anthrax (in sheep and goats)	—	85	85	—	—	—
Northern Province	Rabies	2	13	—	13	—	—
	Anthrax	—	168	168	—	—	—
	Foot-and-mouth	—	985	7	—	978	—
North-Central Province	Foot-and-mouth	—	1437	—	—	1437	—
North-Western Province	Rabies	1	7	3	4	—	—
	Foot-and-mouth	—	75	6	—	69	—
Central Province	Mange (cattle)	45	697	9	—	643	45
	Foot-and-mouth	8	555	1	—	546	8
	Piroplasmosis	—	3	1	—	2	—
	Tuberculosis	—	1	—	1	—	—
	Rabies	—	1	—	1	—	—
Province of Sabaragamuwa	Rabies	—	16	7	9	—	—
	Foot-and-mouth	—	15	—	—	15	—
Province of Uva	Piroplasmosis	—	1	—	—	1	—
	Rabies	1	2	—	2	—	—
Eastern Province	Rabies	1	5	—	5	—	—
	Surra	—	69	69	—	—	—
	Foot-and-mouth	82	615	67	—	471	77
Southern Province	Foot-and-mouth	—	19	—	—	19	—
	Rabies	1	2	1	1	—	—

T. M. Z. MAHAMOOTH,
Deputy Director (Animal Husbandry)
nd Government Veterinary Surgeon.

Peradeniya, CEYLON.
December 1, 1950.

SUMMARY OF OUTBREAKS OF SCHEDULED ANIMAL DISEASES WITHIN THE DOMINION OF CEYLON—MONTH ENDING NOVEMBER 30, 1950

Province	Disease	Fresh cases during the month	Total number from the beginning of this calendar year to November 30, 1950				Balance ill at end of month
			Diseased	Deaths	Shot	Recoveries	
Western Province	Foot-and-mouth	—	67	—	—	67	—
	Rabies	—	1	1	—	—	—
Colombo Municipality	Foot-and-mouth	—	430	—	—	430	—
	Anthrax	—	4	4	—	—	—
	Tuberculosis	—	2	2	—	—	—
	Piroplasmosis	—	6	6	—	—	—
	Mange	—	24	—	—	24	—
	Rabies	4	81	81	—	—	—
Quarantine Station	Anthrax (in sheep and goats)	8	93	93	—	—	—
Northern Province	Rabies	1	14	—	14	—	—
	Anthrax	—	168	168	—	—	—
	Foot-and-mouth	—	985	7	—	978	—
	Pleuro-Pneumonia (goats)	34	34	32	—	2	—
North-Central Province	Foot-and-mouth	—	1,437	—	—	1,437	—
North-Western Province	Rabies	—	7	3	4	—	—
	Foot-and-mouth	—	75	6	—	69	—
Central Province	Mange (cattle)	51	748	13	—	688	47
	Foot-and-mouth	—	555	1	—	554	—
	Piroplasmosis	—	3	1	—	2	—
	Tuberculosis	—	1	—	1	—	—
	Rabies	—	1	—	1	—	—
Province of Sabaragamuwa	Rabies	1	17	7	10	—	—
	Foot-and-mouth	—	15	—	—	15	—
Province of Uva	Piroplasmosis	1	1	—	—	1	—
	Rabies	—	3	—	3	—	—
Eastern Province	Rabies	1	6	—	6	—	—
	Surra	—	69	69	—	—	—
	Foot-and-mouth	—	615	67	—	548	—
Southern Province	Foot-and-mouth	—	19	—	—	19	—
	Rabies	—	2	1	1	—	—

T. M. Z. MAHAMOOTH,
Deputy Director (Animal Husbandry),
and Government Veterinary Surgeon.

Peradeniya, CEYLON.
January 5, 1951.

SUMMARY OF OUTBREAKS OF SCHEDULED ANIMAL DISEASES WITHIN THE DOMINION OF CEYLON—MONTH ENDING DECEMBER 31, 1950

Province	Disease	Fresh cases during the month	Total number from the beginning of this calendar year to December 31, 1950				Balance ill at end of month
			Diseased	Deaths	Shot	Recoveries	
Western Province	Foot-and-mouth	—	67	—	—	67	—
	Rabies	—	1	1	—	—	—
Colombo Municipality	Foot-and-mouth	—	430	—	—	430	—
	Anthrax	—	4	4	—	—	—
	Tuberculosis	—	2	2	—	—	—
	Piroplasmosis	1	7	7	—	—	—
	Mange	—	24	—	—	24	—
	Rabies	2	83	83	—	—	—
Quarantine Station	Anthrax (in sheep and goats)	33	126	126	—	—	—
Northern Province	Rabies	2	16	—	16	—	—
	Anthrax	—	168	168	—	—	—
	Foot-and-mouth	—	985	7	—	978	—
	Pleuro-Pneumonia (goats)	4	38	36	—	2	—
North-Central Province	Foot-and-mouth	—	1437	—	—	1437	—
North-Western Province	Rabies	—	7	3	4	—	—
	Foot-and-mouth	21	96	6	—	80	10
Central Province	Mange (cattle)	42	790	14	—	734	42
	Foot-and-mouth	—	555	1	—	554	—
	Piroplasmosis	1	4	1	—	3	—
	Tuberculosis	—	1	—	1	—	—
	Rabies	—	1	—	1	—	—
Province of Sabaragamuwa	Rabies	2	19	7	12	—	—
	Foot-and-mouth	—	15	—	—	15	—
Province of Uva	Piroplasmosis	—	1	—	—	1	—
	Rabies	—	3	—	3	—	—
Eastern Province	Rabies	—	6	—	6	—	—
	Surra	—	69	69	—	—	—
	Foot-and-mouth	12	627	68	—	553	6
Southern Province	Foot-and-mouth	—	19	—	—	19	—
	Rabies	—	2	1	1	—	—

T. M. Z. MAHAMOOTH,
Deputy Director (Animal Husbandry)
and Government Veterinary Surgeon.

Peradeniya, CEYLON.
January 30, 1951.

SUMMARY OF OUTBREAKS OF SCHEDULED ANIMAL DISEASES WITHIN THE DOMINION OF CEYLON—MONTH ENDING JANUARY 31, 1951

Province	Disease	Fresh Cases during the month	Total number from the beginning of this calander year to January 31, 1951.				Balance ill at end of month
			Diseased	Deaths	Shot	Recoveries	
Western Province ..	—	—	—	—	—	—	—
Colombo Municipality	Anthrax	1	1	1	—	—	—
	Piroplasmosis	2	2	2	—	—	—
	Haemorrhagic Septicaemia	1	1	1	—	—	—
	Rabies	9	9	9	—	—	—
Quarantine Station ..	Anthrax (in sheep and goats)	9	9	9	—	—	—
Northern Province	Pleuro-pneumonia (goats)	18	18	18	—	—	—
North-Central Province ..	Foot-and-mouth	84	84	—	—	—	84
North-Western Province	Black Quarter	3	3	3	—	—	—
	Foot-and-mouth	39	39	2	—	37	—
Central Province	Mange (cattle)	27	27	2	—	—	25
	Piroplasmosis	1	1	—	—	1	—
Province of Sabaragamuwa ..	Rabies	1	1	—	1	—	—
Province of Uva ..	—	—	—	—	—	—	—
Eastern Province ..	—	—	—	—	—	—	—
Southern Province ..	—	—	—	—	—	—	—

T. M. Z. MAHAMOOTH,
Deputy Director (Animal Husbandry)
and Government Veterinary Surgeon.

Peradeniya, CEYLON.
February 22, 1951.

3——J. N. B 6008 (3/51)

METEOROLOGICAL REPORT, NOVEMBER, 1950

STATION	TEMPERATURE				HUMIDITY		Amount of Cloud	RAINFALL		
	Mean Maximum	Offset	Mean Minimum	Offset	Day	Night (from Minimum)		Amount	No. of Rainy Days	Offset
	°	°	°	°	%	%		In.		In.
Agalawatta	—	—	—	—	—	—	—	—	—	—
Anuradhapura	85·9	+0·2	71·4	—0·2	74	93	5·8	8·63	17	— 2·04
Badulla	79·6	+0·3	64·9	—0·6	73	94	5·9	4·63	17	— 5·62
Batticaloa	84·1	0	74·1	—0·2	78	90	6·1	4·43	16	— 9·43
Colombo	85·3	0	73·5	+0·1	74	93	6·0	2·83	15	—10·26
Diyatalawa	73·9	—0·1	59·4	—0·5	79	97	6·4	7·32	18	— 3·10
Galle	83·9	+0·4	74·1	—0·2	76	86	5·4	13·60	20	+ 1·59
Hakgala	—	—	—	—	—	—	—	—	—	—
Hambantota	85·7	+0·4	74·0	0	76	90	6·1	6·28	16	— 1·29
Jaffna	84·0	0	75·1	+0·3	74	84	5·9	6·42	12	—10·85
Kandy	83·8	—0·2	68·0	—0·1	74	92	5·5	7·72	16	— 3·30
Kurunegala	86·4	—0·6	71·9	0	73	90	5·2	9·53	16	— 2·86
Mannar	84·3	—0·3	76·4	+0·8	76	86	6·2	2·08	14	— 8·11
Nuwara Eliya	67·2	—0·5	50·1	—1·2	82	93	5·6	4·16	21	— 5·03
Puttalam	85·3	—0·3	72·8	—0·4	76	93	6·1	6·26	10	— 3·87
Ratmalana	85·9	—	72·6	—	72	93	5·8	3·17	11	— 8·95
Ratnapura	88·6	+1·1	72·2	—0·2	74	93	6·6	9·41	14	— 5·38
Talawakele	73·1	—0·5	56·2	—1·1	78	91	5 8	6·35	17	— 2·15
Trincomalee	83·2	—0·3	74·6	—0·2	80	93	6·1	17·43	19	+ 3·49

WEATHER SUMMARY, NOVEMBER, 1950

Rainfall in November was below normal practically throughout the Island, fairly large deficits occurring over a grater part of it. In October too the rainfall was appreciably below normal in some areas, so that the combined deficiencies during the two months were considerable. The areas affected include a large part of the northern and eastern Districts and some parts of the hill-country, the rainfalls received being less than half the averages which generally range from 20 to 40 inches. In the Nitre Cave District for example the rainfall totals recorded for the two months October/November at Hendon Estate, St. Martin's (Upper) Estate and St. Martin's (Lower) Estate were 15·07, 16·19 and 14·91 inches as against averages of 41·47, 39·96 and 35·37 inches respectively. Similarly in the dry zone, Jaffna College received only 12·76 inches for the two months as against an average of 28·27 inches, Minneriya 7·15 inches as against 22·44 inches, and Rukam 7·33 inches as against 20·57 inches.

In November, the larger deficits (of the order of 10 to 15 inches) occurred in the north, in the south-western low and mid-country and on the north-eastern slopes of the hills, outstanding deficits being 14·17 inches at Hendon Estate, 13·34 inches at Kayts and 13·31 inches at Iddumekelle Estate. There were a few isolated excesses, the largest being 7·02 inches at Embilipitiya (Agricultural Station) and 5·92 inches at Embilipitiya (Irrigation).

Monthly rainfall totals in November generally ranged from 5 to 10 inches. The bigger totals were found along the north-east cost and in places in the south of the Island, the highest being 18·34 inches at Embilipitiya (Agricultural Station) 17·51 inches at Andankulam, 17·43 inches at Trincomalee and 17·40 inches at Forest Hill Estate.

There were only 5 daily falls of 5 inches or over in November, the highest being 5·76 inches at Meeriabedde Estate on the 3rd.

Scattered afternoon or evening thundershowers which were in evidance during the first week became more widespread during the next. Moderately heavy widespread rain was experienced on the 10th. There was a gradual decrease in rainfall during the third week, practically dry weather prevailing on the 20th and 21st. From the 22nd onwards the rainfall was mainly confined to the north and east.

Day temperatures did not deviate much from average, while night temperatures were slightly below average. The highest recorded temperature in the shade was 93·5° at Anuradhapura on the 4th, while the lowest temperature for a low-country station was 65·0°, also at Anuradhapura on the 26th. The lowest temperature for the whole Island was 42·5° at Nuwara Eliya on the 1st.

Humidity was on the whole about 75% by day and 90% by night. Cloud amounts were above average. Wind strength was about normal, the direction being variable.

D. T. E. DASSANAYAKE,
Director.

METEOROLOGICAL REPORT, DECEMBER, 1950

STATION	TEMPERATURE				HUMIDITY		Amount of Cloud	RAINFALL		
	Mean Maximum	Offset	Mean Minimum	Offset	Day	Night (from Minimum)		Amount	No. of Rainy Days	Offset
	°	°	°	°	%	%		Ins.		Ins.
Anuradhapura	83·5	+0·5	68·4	—1·8	74	92	4·4	7·00	16	— 0·52
Badulla	75·6	—1·1	64·2	—0·3	81	94	6·0	6·31	19	— 4·92
Batticaloa	81·5	—0·4	73·5	—0·1	79	90	6·6	9·87	16	— 7·12
Colombo	85·7	+0·2	71·8	—0·6	72	90	4·6	4·27	10	— 1·34
Diyatalawa	70·6	—1·4	57·6	—1·1	84	97	6·0	3·97	18	— 4·10
Galle	82·9	—0·6	72·5	—0·9	77	88	4·7	7·47	17	— 0·35
Hakgala	—	—	—	—	—	—	—	—	—	—
Hambantota	84·3	—0·2	72·5	—0·5	76	90	6·0	1·86	10	— 3·75
Jaffna	82·9	+0·5	72·7	—0·3	73	88	5·4	5·56	12	— 4·83
Kandy	82·3	—0·8	66·4	—0·9	72	92	5·2	2·27	11	— 6·17
Kurunegala	85·3	—0·5	70·1	—0·7	72	93	4·4	2·28	11	— 4·50
Mannar	82·8	+0·1	74·8	0	76	86	4·8	5·17	9	— 2·62
Nuwara Eliya	66·7	—1·0	47·4	—1·6	80	90	4·6	2·92	14	— 4·89
Puttalam	84·8	+0·1	70·2	—1·1	74	93	4·4	6·01	13	+ 0·46
Ratmalana	86·4	—	70·3	—	72	93	4·8	6·21	11	— 0·44
Ratnapura	88·7	+0·9	71·4	—0·3	72	93	6·5	2·90	7	— 6·22
Talawakele	72·8	—0·7	54·4	—1·8	72	81	4·9	2·22	12	— 2·96
Trincomalee	80·8	—0·2	75·5	+0·8	79	82	6·0	8·63	14	— 4·37

WEATHER SUMMARY, DECEMBER, 1950

In December again the rainfall was appreciably below normal practically throughout the Island. This is the third successive month with comparatively low rainfall in the north and east and in the hill-country. On the north-eastern slopes of the hills the total deficiency for the three months was of the order of 25 to 40 inches, while in the north and east the deficiencies ranged from 10 to 20 inches.

The bigger deficits for December (of the order of 10 to 15 inches) were found on the north-eastern slopes of the hills, where averages are high, the largest being 18·51 inches at St. Martin's (Upper) Estate, 18·02 inches at Hendon Estate, and 13·68 inches at St. Martin's (Lower) Estate. In the north and north-east of the Island deficits ranged from 5 to 10 inches. A few slight excesses occurred in the west, the only appreciable amounts being 5·61 inches at Dompe, 5·26 inches at Horagahalande Estate, and 2·95 inches at Moratuwa,

The heaviest rain for the month occurred on the north-eastern slopes of the hills, where several stations recorded totals of over 15 inches, the highest being 19·52 inches at Hendon Estate, 19·05 inches at St. Martin's (Lower) Estate, 18·41 inches at Forest Hill Estate, 18·26 inches at St. Martin's (Upper) Estate and 18·06 inches at Iddumekelle Estate. In the north-eastern low-country the rainfall ranged mainly from 5 to 10 inches, while in the south-west it was generally about 5 inches.

There were only two daily falls over: 5 inches in December, 8·10 inches at Kataragama on the 2nd, and 5·65 inches at Chadiyantalavai on the 9th.

North-east monsoon conditions prevailed generally during the month, but the rainfall was rather irregular. Fairly widespread rain was experienced on a few days: the 1st, 12th, 21st and 25th.

Temperatures were below normal, particularly by night. The highest recorded temperature in the shade was 93·2° at Ratnapura on the 18th, while the lowest temperature for a low-country station was 60·4° at Anuradhapura on the 8th. The lowest temperature for the whole Island was 32·0° (freezing point) at Nuwara Eliya on the 16th. The mean humidity varied from 70 to 80% by day, and from 85 to 90% by night. The skies were more cloudy than usual. Wind strength was about normal, the prevailing direction being north-easterly.

D. T. E. DASSANAYAKE,
Director.

METEOROLOGICAL REPORT, JANUARY, 1951

STATION	TEMPERATURE				HUMIDITY		Amount of Cloud	RAINFALL		
	Mean Maximum	Offset	Mean Minimum	Offset	Day	Night (from Minimum)		Amount	No. of Rainy Days	Offset
	°	°	°	°	%	%		Ins.		Ins.
Anuradhapura	81·8	—1·5	69·8	+0·7	78	93	5·5	10·96	18	+ 5·16
Badulla	74·3	—2·0	64·9	+1·3	87	97	6·9	25·43	24	+15·11
Batticaloa	80·2	—1·3	73·7	+0·2	83	90	7·6	23·53	25	+10·65
Colombo	85·6	—0·9	72·4	+0·7	73	90	6·3	5·41	14	+ 1·45
Diyatalawa	69·4	—2·5	59·5	+2·1	90	97	7·0	16·39	26	+ 9·75
Galle	81·6	—2·3	72·8	—0·1	81	88	6·4	13·98	23	+10·10
Hakgala	—	—	—	—	—	—	—	—	—	—
Hambantota	83·3	—1·8	73·2	+0·6	80	90	6·6	10.97	19	+ 6·97
Jaffna	82·1	—0·9	73·2	+1·2	74	86	5·4	2·83	9	— 1·58
Kandy	80·8	—2·9	67·7	+0·7	78	90	6·3	16·40	20	+10·06
Kurunegala	84·1	—2·5	71·4	+1·7	76	90	6·1	9·74	17	+ 4·63
Mannar	81·8	—1·5	74·5	+0·4	79	86	5·4	7·11	13	+ 3·27
Nuwara Eliya	65·5	—2·3	51·7	+5·3	87	94	6·4	12·47	22	+ 5·51
Puttalam	83·5	—2·1	70·8	+0·9	79	93	5·9	8·66	16	+ 5·23
Ratmalana	86·0	—	70·8	—	74	93	5·9	5·31	14	+ 1·16
Ratnapura	86·7	—2·7	71·9	+0·9	81	95	7·0	7·97	19	+ 1·71
Talawakele	73·5	—0·8	57·0	+1·8	76	82	6·0	8·35	21	+ 4·48
Trincomalee	79·3	—1·3	75·8	+0·6	84	84	6·8	12·39	20	+ 4·08

WEATHER SUMMARY, 1951

The main feature of the weather in January was the occurrence of unusually heavy rains on the eastern and north-eastern slopes of the hills and in the southern half of the Eastern Province, which resulted in extensive floods in the Batticaloa District. In these parts there was, more or less, continuous rain from the 8th to 18th, with outstanding large falls on the 9th and 17th. Active north-east monsoon conditions were responsible for most of the precipitation, while from the 15th to 18th the rainfall became fairly widespread on account of a trough of low pressure to west of Ceylon.

Heaviest rain occurred on the north-eastern slopes of the hills where Hendon Estate recorded as much as 81·98 inches, St. Martin's (Lower) Estate 78·58 inches and St. Martin's (Upper) Estate 76·23 inches for the month. The total at Hendon included 5 daily falls over 5 inches, while those at St. Martin's (Upper) and (Lower) each included 4 such falls. For these 3 stations these are the largest January totals since 1933. In that year Hendon aggregated 122·20 inches for January, St. Martin's (Lower) 93·40 inches and St. Martin's (Upper) 123·09 inches.

Other outstanding totals for January were 61·84 inches at Mousakande Estate, 61·55 inches at Dooroomadella Factory and 61·09 inches at Forest Hill Estate.

The rainfall in the southern parts of Batticaloa District was generally of the order of 30 inches, while in the south-west of the Island it ranged mainly from 5 to 15 inches. Least rain was experienced in Jaffna District where the monthly totals were below 5 inches.

The rainfall over the Island was above normal except in Jaffna District where it was slightly below. Excesses at several stations on the eastern and north-eastern slopes of the hills exceeded 20 inches, the highest being 44·33 inches at St. Martin's (Lower) Estate, 41·98 inches at Hendon Estate, 36·19 inches at St. Martin's (Upper) Estate, 35·33 inches at Timitar Estate, 33·87 inches at Dooroomadella Factory and 33·28 inches at Pallegama. Comparatively large excesses were also found in the southern parts of Batticaloa District.

There were more than a hundred daily falls over 5 inches in January, nearly half of them occurring on the 9th and 17th. The greatest falls were 10·42 inches at Unnichchai on the 10th, 9·60 inches at Kataragama on the 15th and 9·02 inches at St. Martin's (Lower) Estate on the 10th.

Temperatures were well below normal by day and above normal by night. The highest recorded temperature in the shade was 92·1° at Ratnapura on the 31st, while the lowest temperature for a low-country station was 61·4° at Anuradhapura on the 6th. The lowest temperature for the whole Island was 41·8° at Nuwara Eliya on the 1st. The mean humidity varied from 75 to 85% by day, and from 85 to 95% by night. The cloud amounts were above average. Wind strength was about normal, the prevailing direction being north-easterly.

D. T. E. DASSANAYAKE,
Director.

METEOROLOGICAL REPORT, FEBRUARY, 1951

STATION	TEMPERATURE				HUMIDITY		Amount of Cloud	RAINFALL		
	Mean Maximum	Offset	Mean Minimum	Offset	Day	Night (from Minimum)		Amount	No. of Rainy Days	Offset
	°	°	°	°	%	%		In.		In.
Agalawatta	—	—	—	—	—	—	—	—	—	—
Anuradhapura	85·1	—2·0	66·7	—2·8	68	92	4·6	3·29	6	+ 1·57
Badulla	77·4	—1·7	62·2	—0·8	72	97	5·4	7·30	8	+ 4·13
Batticaloa	81·6	—1·4	72·2	—1·5	77	93	6·2	8·18	9	+ 3·97
Colombo	85·3	—2·0	70·9	—1·2	72	90	5·7	1·00	6	— 1·60
Diyatalawa	74·9	+0·2	56·1	—0·7	68	85	5·3	2·64	8	+ 0·27
Galle	83·2	—2·1	73·4	—0·3	74	86	5·7	7·79	14	+ 4·50
Hakgala	—	—	—	—	—	—	—	—	—	—
Hambantota	84·5	—1·5	72·1	—0·9	76	90	6·0	5·61	6	+ 4·15
Jaffna	83·9	—1·7	69·3	—3·1	69	90	4·9	1·67	2	+ 0·21
Kandy	84·7	—2·0	65·2	—1·8	67	89	5·4	3·25	9	+ 0·94
Kurunegala	86·8	—3·3	68·2	—1·4	68	95	4·6	2·27	6	+ 0·28
Mannar	83·3	—3·0	72·2	—1·6	72	88	4·9	4·49	3	+ 2·79
Nuwara Eliya	69·0	—0·6	45·1	+0·3	70	86	5·2	4·26	8	+ 2·27
Puttalam	85·0	—3·4	68·5	—1·8	71	95	4·7	1·66	4	+ 0·29
Ratmalana	85·5	—	69·6	—	72	93	5·2	1·54	5	— 1·82
Ratnapura	89·8	—1·8	71·1	—0·2	70	93	6·4	5·04	13	— 0·26
Talawakele	75·3	—1·2	53·0	—1·5	—	—	3·2	2·99	9	+ 1·02
Trincomalee	80·7	—1·9	74·2	—1·6	76	84	6·0	3·67	3	+ 1·02

WEATHER SUMMARY, FEBRUARY, 1951

The rainfall in February was above normal over a large portion of the Island, the larger excesses (of the order of 5 to 10 inches) occurring in Badulla and Batticaloa Districts and in the neighbourhood of Vavuniya. Keenakelle Estate, Badulla, recorded 11·36 inches above the average for the month, while other outstanding excesses were 9·24 inches at Opata, 8·99 inches at Pulukunavi, 8·88 inches at Morawaka, 8·59 inches at Manalputty Aar and 8·30 inches at Arawa Estate. Deficits were generally small and occurred mainly in the west and south-west and on the north-eastern slopes of the hills. The biggest deficits were 3·95 inches at Gikiyanakanda Estate, 3·43 inches at Gonapenigala Estate, and 3·40 inches at Horana.

The largest monthly totals (of the order of 10 to 15 inches) occurred scattered on the north-eastern slopes of the hills and to south of Batticaloa, Keenakelle Estate, recording as much as 18·13 inches. Other outstanding totals were 15·83 inches at Millews 15·08 inches at Ledgerwatte Estate and 15·07 inches at Narangalla Estate, Badulla. Least rain was experienced along the west and south-west coasts where the monthly totals were below two inches.

There were 25 daily falls over five inches in February, almost all of them occurring between the 7th and the 9th. The heaviest falls were 7·80 inches at Kirklees Estate and 7·30 inches at Ledgerwatte Estate, both on the 7th.

The month started with comparatively dry weather. Under the influence of a low pressure wave in the Comorin Area, conditions became unsettled on the 6th and widespread rain, with occasionally large falls, was experienced during the next three days. The weather became settled again for a few days from the 12th. Local afternoon or evening thundershowers that set in after the 18th, resulted in fairly widespread rain on several days during the rest of the months.

Temperature were well below normal, both by day and night. The highest recorded temperature in the shade was 93·1° at Ratnapura on the 21st, while the lowest temperature for a low-country station was 63·7° at Puttalam on the 28th. The lowest temperature for the whole Island was 34·3° at Nuwara Eliya on the 5th. The mean humidity varied from 65 to 75% by day, and from 85 to 95% by night. The skies were more cloudy than were usual in February. The wind strength was slightly below average, the prevailing direction being mainly north-easterly.

D. T. E. DASSANAYAKE,
Director.